Steelcrete

TRADE MARK

REGISTERED

Steelcrete

EXPANDED METAL

THE CONSOLIDATED EXPANDED METAL CO'S.

PITTSBURGH NEW YORK

A HAND-BOOK OF DESIGN CONTAINING TABLES, STANDARDS AND USEFUL INFORMATION APPERTAINING TO

The "Steelcrete" System

of Reinforced Concrete

Steelcrete

TRADE MARK

REGISTERED

THE CONSOLIDATED EXPANDED METAL COMPANIES

PITTSBURGH, PA. NEW YORK.

Third Edition

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No. C 6444

It will be noted that this is of the loose leaf form.

It is our intention to forward to you, from time to time, for insertion, additions such as cost of installations, data compiled from tests, and illustrations of construction methods.

INDEX

"Steelcrete" the oldest Reinforcement

"Steelcrete" Expanded Metal is the oldest and most widely used concrete reinforcement.

Had we no further arguments to substantiate our claims for its superiority than the list of innumerable buildings and varied construction in which it has been used, such a roll would constitute an array of figures calculated to inspire confidence in the most conservative, who, never having trod the path before, is timid as to his choice of a concrete reinforcement. Elsewhere we have given figures covering the extent of its use. Suffice it to say here that "Steelcrete" Expanded Metal has been used not only in every portion of the United States, but in every corner of the civilized world. Indeed, wherever modern civilization has thrust itself, "Steelcrete" Expanded Metal construction will be found in the most important works of that country. Of American invention, no product could be more widely indorsed by foreigners. Not only has this type of reinforcement the unanimous approval of the best engineers of the civilized world, but their enthusiastic indorsement as well.

We recognize, however, that this is only incidental to its worth. Continued success is an indication of confidence on the part of the buyers in the material purchased. We submit that no metal fabric could stand in the front rank of concrete reinforcement for almost twenty years, practically since the birth of the industry, under the critical scrutiny of the best known engineers of the entire civilized world unless its underlying principles were fundamentally correct.

What "Steelcrete" Is

Before taking up the distinctive features of advantage it is necessary to describe just what is meant when we speak of "Steelcrete" Expanded Metal. Notwithstanding its wide application, it is not uncommon to find many engineers and users of this metal who are ignorant of the meaning of the term. Owing to the fact that in recent years imitations have appeared to injure its good name, it is now necessary to clearly draw the line between the true and the false product that purchasers may be able to clearly distinguish and appreciate the difference.

"Steelcrete" Expanded Metal is NOT a steel plate which has been slit in one operation and, by a second operation, pulled and enlarged into a large sheet of diamond shaped meshes. In the "Steelcrete" process the diamond shaped meshes are formed by cold drawing the metal under an enormous speed, the plate having been previously covered with oil.

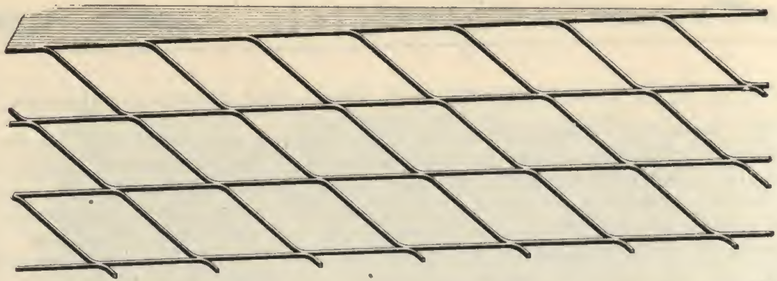


Fig. (1)—Showing method of manufacture of an imitation of "Steelcrete" Mesh.

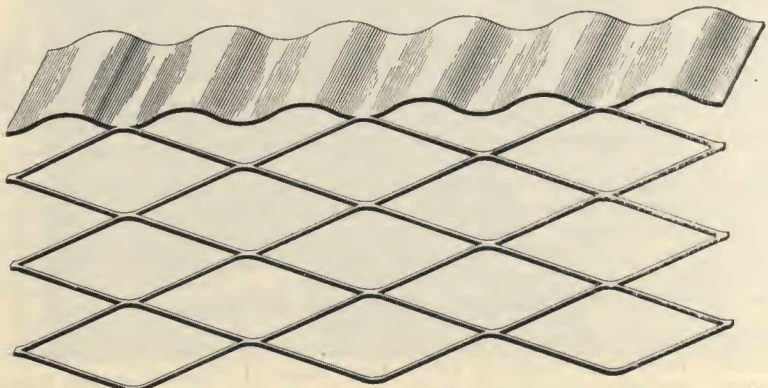


Fig. (2)—Another imitation of "Steelcrete."

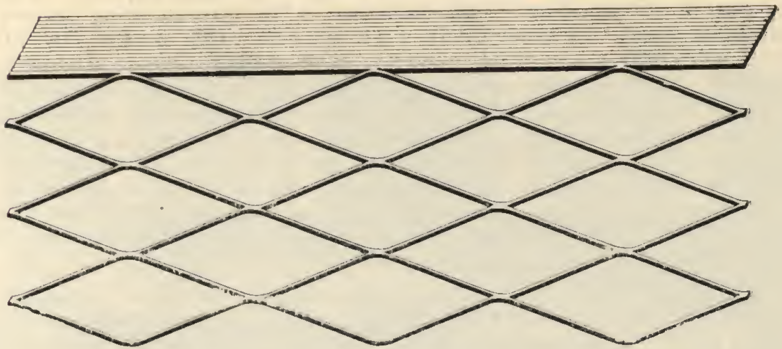


Fig. (3)—The true "Steelcrete"—showing correct method of manufacture.

WHAT IS "STEELCRETE" MESH?

The preceding illustrations depict the difference between the true and the false product. "Steelcrete" alone of the above shown is manufactured by a cold drawn process. It is the only mesh that possesses great unit strength and a high elastic limit. A mesh that is not cold drawn but merely deployed is necessarily low in value in both of these properties. The distinctive features of "Steelcrete," in addition to the above, is its uniformity of quality and stiffness. It makes a taut reinforcement, requiring no stretching to take the "waves" out of it. You can only be sure of what you are getting by specifying "Steelcrete" Mesh—not just merely Expanded Metal.

The illustrations clearly depict the difference between the two. It is this cold working of the steel at an exceedingly high speed that is the distinguishing feature of the "Steelcrete" Expanded Metal. IN ONE CASE THE METAL HAS BEEN DEPLOYED, WHILE IN THE SECOND CASE THE METAL HAS BEEN COLD DRAWN TO ITS MESH SHAPE. The true sheet can be readily distinguished from the false product by the regularity of its strands and the better mechanical appearance of the material, but the most significant difference to be noted is in the stiffness. It is possible for a man to lift a sheet of "Steelcrete" Expanded Metal twelve feet long from one end by holding that end against the body, the hands gripping the strands three feet away, the remainder of the sheet extending out horizontally with an imperceptible droop at the far end. This is not possible in the false product. The advantage of this stiffness will be taken up more fully in a subsequent paragraph.

A Cold-drawn Fabric

The effect of the process on the steel in making "Steelcrete" Expanded Metal is not unlike the cold twisting of a square bar, the cold rolling of a steel shape, or in fact the cold working of any piece of steel by which, due to a strange phenomenon characteristic of this metal, the quality is improved, the ultimate strength increased, and its elastic limit more than doubled. The original plate is of soft steel containing a low percentage of carbon, which is another way of saying that it is obtainable in an absolutely uniform quality. In the finished product the ultimate strength has been raised 20 to 50 per cent., and its elastic limit increased by 100 per cent.

Distinctive Features

From the very beginning of reinforced concrete work the success of Expanded Metal as a reinforcement has been continuous. Innumerable tests have been made, and invariably the results have proved better than the calculations. "Steelcrete" Expanded Metal has three distinctive features which make for its superiority as a reinforcement for concrete. These features are entirely unique with the material and not encountered in any other fabric.

High Elastic Limit

(1) The cold working of the steel in the process of manufacture, which has been briefly referred to, increases the elastic limit of the steel about 100 per cent. "Steelcrete" Expanded Metal is, strictly speaking, a material with a high elastic limit. This ranges from 55,000 to 65,000 lbs. per sq. in. The value this gives as a concrete reinforcement will be recognized by all users of this class of material. In addition to this great advantage is the guarantee in uniformity of the material due to the soft steel plate from which the fabric is made. A high elastic limit is usually synonymous with uncertainty. In "Steelcrete" Expanded Metal we have a material possessing a high elastic limit, and at the same time a guaranteed uniformity of quality.

Ductility

(2) The diamonds, or quadrilaterals, of the sheet under severe loading tend to close. The effect of this contraction in the meshes is to give the fabric a ductility unencountered in any other reinforcement having a high elastic limit. As this closing up of the meshes does not take effect except under severe loading, to the advantages of a high elastic limit are added those of a ductile material. Unless the slab is under-reinforced, when "Steelcrete" Expanded Metal fails, it fails slowly. This feature will be appreciated by engineers and experts in building construction.

(3) The effect of this closing up of the diamonds, in addition to giving the fabric ductility, is to introduce a compression into the concrete which at this point is in tension. This, as will be noted at once, is highly beneficial to the slab, and greatly adds to its strength. This feature is entirely unique with Expanded Metal. It is encountered in no other reinforcement, and is recognized and highly commended by concrete experts everywhere who have tested this material to destruction.

To these three distinctive features of Expanded Metal may be added many others, such as the perfect bond attained between the steel and the concrete; perfect distribution of the steel, whereby the designer is assured that it will be located just where his calculations assumed it to be, and numerous others. These points will now be taken up separately, that the importance of each may be properly emphasized. We are able to satisfy the most skeptic in every case. We have data and the results of tests on hand covering every feature. It is not possilble to give such data in a brief circular such as this, owing to its volume. We will be glad to correspond with any one who is sufficiently interested to go into the matter further with us.

THE HIGH ELASTIC LIMIT.

Its Importance

That the high elastic limit is an advantage in concrete reinforcement is a statement which must be accompanied with certain reservations. In general, it may be stated that steel is a ductile material in comparison with concrete. In concrete this quality is greatly lacking. If concrete and steel are to work together, it is plain that they must stretch together. After the steel has passed its elastic limit its elongation becomes so pronounced that the concrete cracks and breaks, and to all intents and purposes the beam has failed. Until this critical point has been reached the deflection on a beam is negligible, and on a slab of small span is scarcely perceptible. Evidently, high elastic limit adds greatly to the load-bearing powers of the slab, supplying a factor of safety not found in a soft steel. As long as tests are regarded as the basis of comparison for steel reinforcements, so long will the materials possessing a high elastic limit be regarded as superior.

Methods of Attainment

A high elastic limit in steel can be attained in three ways only:

(1) By the increase of the percentage of carbon in the steel.

(2) By the special process of repeated cold drawing and annealing encountered in the manufacture of wire.

(3) By the cold working of a soft steel, as in cold-twisting squares, or in cold rolling bars, or in the making of "Steelcrete" Expanded Metal.

Effect of Carbon Contents

We will consider the first and last cases together, and the second will be taken up subsequently. In the last case referred to the material is a soft or medium steel containing between .08 per cent to .20 per cent. of carbon. This is usually designated in the trade terms as 8 to 20 carbon. A high carbon steel, such as is commonly used in concrete work, in order to attain the high elastic limit reached, contains from .40 per cent to .50 per cent of carbon, or, in trade terms, 40 to 50 carbon. It is an incontrovertible fact that a high carbon steel cannot be attained in the present market in a uniform quality except under conditions of inspection that do not permit its use as a commercial reinforcement. On the other hand, it is indisputable that a low carbon steel is easily obtained commercially in a uniform quality. When high carbon steel is bought, an inferior product is bought. On account of its unreliability its lowest values can only be considered in the selection of the working stresses.

"Steelcrete" Expanded Metal contains between 8 to 12 carbon, and is therefore a uniform product. This Expanded Metal could not be made from non-uniform steel, as the process of manufacture, to be a commercial success, absolutely requires a uniform material.

With high carbon bars must be classified the ordinary commercial wire meshes often used as a reinforcement. Wire mesh is not uniform in quality. While published tests show average values of 85,000 to 95,000 lbs. per sq. in. in ultimate strength, and elastic limits of over 60,000 lbs. per sq. in., tests on commercial products show a range of from 60,000 to 120,000 lbs. per sq. in. in ultimate value, and in elastic limit of from 40,000 to 97,000 lbs. per sq. in. While the average values may be high, we submit that average values have no place in conservative engineering. Inasmuch as the strength of a chain is that of its weakest link, the minimum values should in every case be required. Furthermore, we submit that it should be prohibitive to use a material with a variation in quality as above stated. The ranges above given are unquestionably conservative, and the actual range is undoubtedly greater.

Superior Quality of "Steelcrete"

To summarize, the high elastic limit, while undoubtedly desirable, must not be attained at the sacrifice of quality. It should not be overlooked that "the quality remains long after the price is forgotten." "Steelcrete" Expanded Metal stands for superior quality; a uniform product with a high elastic limit.

The second distinctive feature of "Steelcrete" Expanded Metal which is intimately connected with the subject of the high elastic limit is ductility.

Value of Ductility

The property of high elastic limit is generally accompanied with a great decrease in the ductility of the material. The effect of this on the safety of a building should not be overlooked. It is never possible to calculate all of the loads that a building will be required to sustain. The falling of a two-ton load on a floor from the height of one foot will produce stresses on the whole building that will far exceed the common calculated quiescent loads. A shock due to internal or external explosions, earthquake shocks, common shocks encountered in the erection of the structure; none of these can be calculated. Conservative engineers provide for them by selecting a material which possesses ductility; in other words, which will yield under shock rather than snap in two, such as would be the case with a material possessing a low ductility. Such materials should be absolutely prohibited on beams and girders, as upon them depends the safety of the building. Elsewhere we have spoken of the tendency of the diamond meshes in an Expanded Metal sheet to close under severe loading. This will be readily granted by an observer. The effect of this feature on Expanded Metal embedded in concrete is obviously to give the reinforcement a ductility unencountered in any other fabric possessing a high elastic limit. As this closing cannot take place except under a severe loading or shock, the advantages of a high elastic limit as well as that of a ductile metal are attained.

An Impartial Opinion

This feature of Expanded Metal, namely, the tendency of the diamond meshes to close, has the effect of introducing a compression into the concrete which is under tension at this point. The immediate effect is to lower the neutral axis in the slab, which increases the effective area of concrete available for the resistance of compressive stresses and decreases the stresses in the extreme fibres. The beneficial effect cannot be denied. It has been recognized by concrete experts the world over. The following extracts describe it better than we could ourselves. They are taken from the 600-page exhaustive treatise on Reinforced Concrete by Charles F. Marsh, page 54:

"A beneficial action appears to be set up in the slab, due to the tendency of the meshes to close up under bending. It can be easily seen if the meshes close up by a lengthening of the longer, and a shortening of the short diagonal, the area within the mesh must become reduced, and consequently the enclosed concrete will be compressed. This is a very valuable property, since, if the sheets are so placed that the greatest tensile stresses act in the direction of the longest diagonal, it causes the concrete in the lower portion to be under compression, instead of tensile stresses, as is the case with most methods of reinforcement. The sheets are made in many different strengths, so that almost any size of piece can be economically reinforced. Where one sheet is not of sufficient length or width, a slight overlapping of the sheets in the concrete gives the necessary continuity, since its form renders any slipping through the mass of concrete practically impossible."

Also on page 296 of the same treatise:

"There is more stretching of 'expanded metal' previous to rupture than of an ordinary rod r wire reinforcement. Reinforcements in the nature of a woven mesh probably behave in a somewhat similar manner to 'expanded metal,' but not so pronounced.

"The values of the unit moment of resistance, $\frac{M}{bh^2}$, are higher for a similar percentage of metal in slabs reinforced with 'expanded metal' than in those with longitudinal and transverse rods."

THE CONTINUOUS BOND IN FLAT ARCH CONSTRUCTION.

Some reinforcements in the market, manufactured and sold in rolls, lay so much stress on the continuity of their material that it may be implied that this is its chief claim to superiority. We have already seen that the quality of such material is uncertain, hence unreliable. We are now prepared to show that the theory of the much-heralded continuous bond is exaggerated—to a very small extent exists in practice—and this can be clearly demonstrated.

A Continuous Beam or a Flat Arch?

The common form of construction in strictly fireproof buildings is as per sketch. Occurring in adjoining spans, it has the appearance of continuous beam construction. Text books, as well as building laws, err in computing them as such. In the absence of a proper formula for computing a flat arch, engineers have been forced to use continuous or fixed beam formulae, which, however fallacious their application to this case may be, possess the redeeming feature of erring on the side of safety. The discrepancy between theory and tests is too great to be ignored. That this construction does not behave like a beam, but rather as an arch, can be noted by any casual observer of a test. This fact is now generally recognized and admitted by even the warmest advocates of the continuous bond.

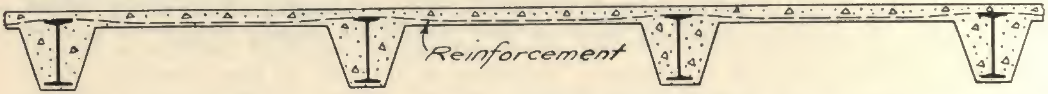


Fig. (4)—This sketch shows a common method of reinforcing in fireproof buildings. It has the appearance of continuous beam construction. Under tests its behavior is more like the arch construction shown in the next sketch. The sustaining powers of the construction shown in this sketch is three or four times greater than the loads calculated by the ordinary continuous beam formulae.

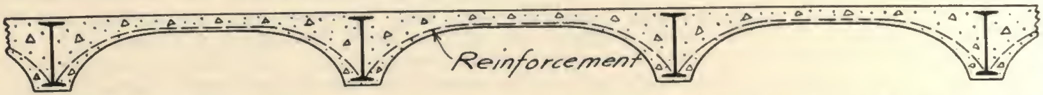


Fig. (5)—A flat segmental arch showing the similarity between it and the flat arch above.

Has an Arch Tension at the Abutment?

A vital difference exists between these two types of structures, namely, the continuous beam and the arch. The continuous beam implies a high tensile stress in the upper part of the slab over the support. The arch implies only a thrust or compression at the support. This difference is of the highest importance. If it could be demonstrated that an arch exists in the form of construction under discussion, instead of a continuous beam, it would follow with indisputable logic that little tensile stress could then be transmitted from arch to arch any more

than in a series of brick or segmental concrete arches. The reinforcement over the support would therefore be useless. That this is actually the case can be clearly proven. It is admitted by all close engineer-observers. Three distinctive points can be cited to substantiate the argument.

Tests Versus Theory

(1) The loads borne by these flat slabs are greatly in excess of those computed under continuous beam formulae. So great is this difference that slabs which do not figure for a safe load of over 50 lbs. per sq. ft. with a presumable factor of safety of 4 will actually carry over 1,500 lbs. per sq. ft. before failure is reached. If the sustained loads are used as a basis of computation for the stresses in the steel, they would imply that a stress existed there of over 300,000 lbs. per sq. in., which is absurd and unsupported by facts, as we know that the steel is not good for more than 80,000 lbs. per sq. in. This discrepancy between tests and theory is recognized now by some manufacturers of slab reinforcement, who do not issue tables for the use of their material, but instead, give a series of slabs and spans which have been tested and which are guaranteed to sustain a specified load under a stated factor of safety. The present New York City building code takes advantage of this arch action in the slabs, and will accept any system of construction in cinder concrete for any stated load which will sustain a test load ten times greater. Notwithstanding this enormous factor of safety, the actual loads for which given systems or styles are passed are two to four times as great as would be permitted under the common continuous beam formulae.

(2) If the condition of a continuous beam existed there would be noted an exceedingly high tensile stress over the support equaling the tensile stress at the center of the span. That this stress does not exist may be noted by any close observer of the above-mentioned tests. Cracks do not appear at this point as under the slab at the center of the span. Fine tension cracks are sometimes seen, but only preliminary to failure when the loading has caused such a large deflection in the middle of the span that will necessarily put tension in the upper portion near the support. This would be true in any arch that is weak at the center. This should not be confounded with a true negative bending moment, such as would exist in a continuous beam. A not uncommon form of construction is given in the sketch. This form of construction, reinforced with a great many systems, has been tested to destruction under the supervision of the building department of New York City, and the results of these tests are on record. It will be seen that it is the usual practice to rest the reinforcement on the supporting beam actually 1½ inches from the extreme fibers of the top. As the slab is commonly 4 inches thick, the lower inch serving only as fire or rust protection, the effective

depth is merely 3 inches. The top reinforcement, therefore, is placed in practice actually at, if not below, the neutral axis, where it could not possibly take any tension, if such existed. In lieu of the fact that the reinforcement is ineffective to take tension at this point, and whereas it is known that the concrete alone is negligible as regards taking tensile stresses, it is reasonable to suppose in the absence of any but very fine cracks that very little, if any, such tension exists.

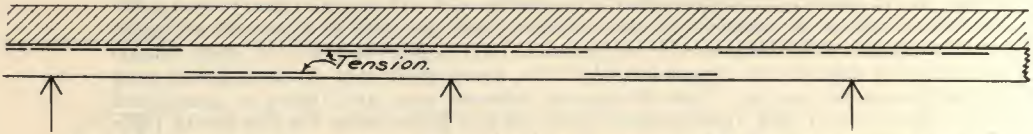


Fig. (6)—The dash lines indicate the theoretical location of the tensile stresses in a continuous beam construction.

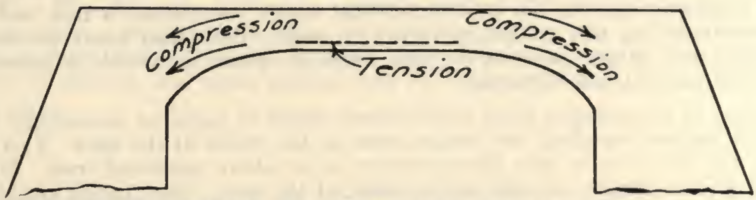


Fig. (7)—The dash line indicates the theoretical location of the tensile stresses in flat arch construction.

(3) In a series of tests to determine the efficiency of "Steelcrete" mesh in flat arch construction, conducted during the spring of 1911 by the Materials Testing Laboratory of the Carnegie Technical Schools, Pittsburgh, Pa., these slabs were carefully observed. The above-mentioned points were every one confirmed. In addition tie rods had been placed connecting the I-beams supporting the slabs, these rods serving as the only connection between the beams and located immediately outside the arch. It was impractical to gauge the tension in the tie rods due to the enormous thrust of the arches, but that they behaved as if under high tensile stress was admitted by all bystanders. A sharp metallic ring would be noted when the tie rods were struck with anything solid.

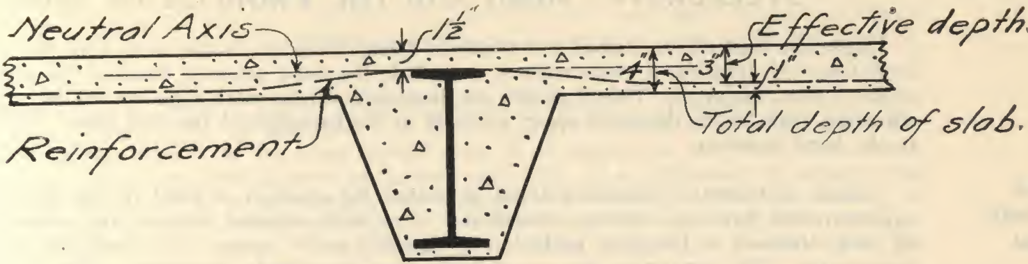


Fig. (8)—Illustrating the common method of placing the reinforcement in the construction shown in Fig. (4). The location being at, if not below, the neutral axis at this point, and the absence of cracks in the slabs demonstrate the fact that there is little, if any, tension over the support in this form of construction. See the discussion of this construction on page 11.

We submit that the enormous loads carried by these slabs, far exceeding all calculations of continuous beam construction, the absence of tension over the support, the tension noted on the rods connecting adjoining beams; all of these points can only be explained by an arch action.

If no tension exists over the support, it follows that no tensile stresses can be transmitted between adjoining spans. To anchor the reinforcement in the adjoining slabs would imply that the tension would be transmitted over the support. We have seen that the arch construction will not transfer any tension over the support. Hence it must be admitted that there can be no advantage in continuing the reinforcement other than for the practical reasons encountered in some styles of construction. These will be shown subsequently.

It will be argued that this arch action takes effect only in small span construction. It has been noted in spans up to 15 feet, and this covers all practical cases encountered in flat slabs.

"STEELCRETE" MESH AND THE PROBLEM OF BOND.

None the least of the lessons to be learned from the tests of flat arches is the tremendous importance of securing a reinforcement in which the bond attained between the steel and the concrete is a maximum. This is doubly so, inasmuch as the anchorage cannot be made in the adjoining span but in the short space available in the haunches of the arch only. This brings us to the bond question.

The "Steelcrete" Bond

When "Steelcrete" Expanded Metal is chosen the question of bond is one about which the engineer need have no concern whatsoever. The bond attained between the diamond meshes, all under tension, is the most perfect that ingenuity could devise. No possibility of slipping is encountered. The connecting ties are stronger than the strands themselves. They do not depend on the care of a common laborer in their manufacture, as it is mechanically impossible to vary this tie a measurable amount. The possibility of slipping is eliminated from reinforced concrete work. When the steel has slipped it can take no stresses from the concrete.

Steel and concrete, by a fortunate combination of desirable properties, unite to form a building material surpassed by none. In order for them to work together it is evident that the bond between them should be as nearly perfect as possible, as the stresses must be continually transmitted from the steel into the concrete and from the concrete into the steel. It is evident from the inspection of a sheet of "Steelcrete" mesh that the bond attained by the enmeshing in the concrete is perfect. There is seen to be no possibility of slippage. In addition to this, the individual strands have the rough surface of a sheared bar, which makes an ideal grip for the cement.

As a medium for mechanical bond, the surface offered by a wire, galvanized or plain, is obviously inferior. A slight pull will destroy the bond, there being no pits or small indentations to mechanically aid the concrete. This fact having been recognized, cross-wires are either welded to or wrapped around the main longitudinal wires in order to increase the mechanical bond. These mechanically attached cross-wires do not offer a proper guarantee against slipping. When the main longitudinal wires are subjected to great strain their cross-section is reduced. This reduction of the cross-section immediately destroys the tight hold of the cross-wires, and the mechanical bond offered by them is destroyed.

"Steelcrete" an Efficient Reinforcement

Not infrequently the cross-wires in wire fabric are presumed to carry a proportion of the tension that can only be taken by the longitudinal wires, and their full cross-sections added to them. We maintain such designs are inexcusable, and serve only to injure the good name of reinforced concrete. This building material has received well-merited praise everywhere for its excellence as such, but it may be abused and rendered unfit for use by reckless design under the stress of competition.

The weight of the fabric is greatly increased by the cross-wires; oftentimes nearly doubled. It should not be forgotten by the purchaser that he is paying for these cross-wires, which are ineffective in taking tension, at the same pound price he is paying for the longitudinal wires, which are alone effective, and which alone he is concerned with. It is reasonable to suppose that of two fabrics, equally effective in strength, one weighing more than the other, the heavier, in order to meet the price of the former, can only do so at the expense of something, and that something is the quality of the material. When "Steelcrete" Mesh is specified the purchaser pays for effective cross-section only.

When you buy reinforcement, BUY REINFORCEMENT.

THE FLAT SHEET vs. THE ROLL.

A Reinforcement for Unskilled Labor

Reinforced Concrete has been sometimes called Structural Concrete. The fact is thereby implied that it is subject to mathematical investigation. Its stresses and their characters may not be as definitely known as those of structural steel, but the function of each member has been empirically ascertained, more especially that of the steel and its location in the concrete. "Steelcrete" Mesh offers a complete solution of the uncertainty encountered in the placing of the steel in the concrete. It is pre-eminently a reinforcement for unskilled labor. Engineers may figure long over and delve deeply into their mathematics, but it must be admitted that it is the "man behind the shovel" who determines the final position of the neutral axis. It is brawn rather than brain that finally determines the safety of the structure. All modern engineering is concentrated in an effort to eliminate the uncertainty problem and take away from unskilled labor the ability to destroy a structure by ignorance of the essentials. "Steelcrete" Mesh shipped in flat sheets offers a complete solution to this problem. The foreman on the job does not require ability to read a blue print. A large area may be covered without spacing. The stiffness of a "Steelcrete" Expanded Metal sheet has already been referred to. The ease in handling offered by comparatively small. stiff, flat sheets makes it the popular reinforcement for the contractor.

A Guarantee of Safety

"Steelcrete" Mesh lies in the plane of tension designed for it. This is not so in the long roll of reinforcement. The long roll does not offer the guarantee of placing the reinforcement exactly as required. While cross-wires may space it correctly in a horizontal plane, the unrolled fabric, however, has a wavy or warped form in practice, offering an element of uncertainty as regards its position in a vertical plane. If in a common slab, with an effective depth of only three or four inches the reinforcement, because of its form, becomes displaced a half inch in vertical direction, the strength of the slab becomes greatly impaired. THE FACT THAT IT TESTS WELL PROVES LITTLE. THE PLACING IS THEN UNDER EXPERT SUPERVISION. In practice, however, the placing is left to unskilled labor. The position of the reinforcement in a vertical position is obviously of far greater importance than in a horizontal direction.

A reinforcement that does not rest absolutely flat, but curves vertically even to a slight extent, cannot prove effective until it has stretched tight. This necessitates a slipping in the concrete, and a breaking of the bond in the readjustment of the steel. The detriment to the slab is obvious. This is all avoided by the use of "Steelcrete" Mesh. The correct position of the steel is assured, both vertically and horizontally. No slipping in the concrete is necessary for initial tension. Unskilled labor gives satisfaction in placing. The architect or engineer is relieved of anxiety over an uncertain problem, while the contractor is freed from the responsibility of a matter he feels should be beyond his sphere.

THE LAP.

Flat sheet reinforcement requires the lapping of adjoining sheets in order to cover a large area, under some forms of construction necessitating a uniform cross-section throughout. Unless otherwise stated, the proper lap of two sheets is eight inches or one diamond, and *may be made at the center of the span* as well as any other place it may occur. The strength of the bond is sufficient then to transfer the full strength of the steel. This has been demonstrated repeatedly wherever "Steelcrete" Mesh has been used.

The following points should be noted about the strength of a lap. Reinforcing steel, if lapped 50 times its diameter, develops the full strength of the steel with a factor of safety of 3. Figured under this formula, a lap of one diamond offers ample strength for this purpose. To further emphasize this fact, the following tests were recently made under our direction to dispel any doubt that may exist:

MATERIALS TESTING LABORATORY CARNEGIE TECHNICAL SCHOOLS.

A Convincing Test

Pittsburgh, Pa., February, 1911.

TESTS OF BEAMS

FOR

THE CONSOLIDATED EXPANDED METAL COMPANIES.

Three beams were made in order to test the efficiency of different laps of 3-9-175 "Steelcrete" Expanded Metal.

The beams were 6x10 inches by 7 feet, and were reinforced with 9 inch strips of 3-9-175 "Steelcrete" Expanded Metal, at a distance of 1 inch above the bottom of the beam, the lap being at the center of the beam. The proportions of the gravel concrete were: 1, 1½, 4½, and it was machine mixed.

The beams were broken at the age of 26 days with an Olsen Universal Machine, the load being applied at the third points, on a span of 6 feet. See sketch below.

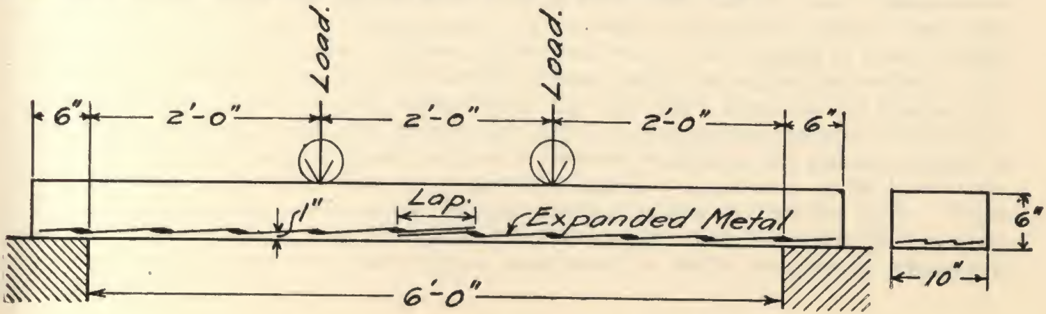


Fig. (9)—Method of construction used in lap tests.

A concrete cylinder 8 inches in diameter and 12 inches high was made from each batch of concrete, and the compression strength of these cylinders exceeded 2,000 lbs. per sq. in. at 26 days.

The following are the results of the beam tests:

Beam No.	Lap.	Total load "P" at failure.	Cause of failure.
"A1"	4 inch	2945 lbs.	Slipping of steel at lap.
"A2"	6 inch	3220 lbs.	Tensile stress in the steel exceeding its elastic limit.
"A3"	8 inch	3085 lbs.	Same cause as "A2."

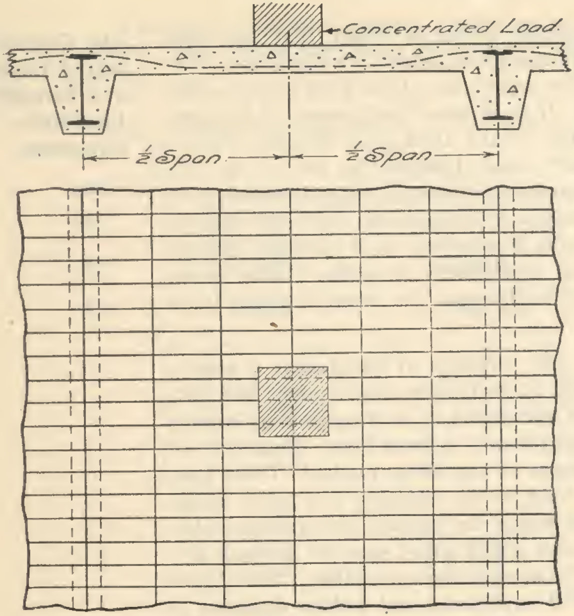
(Signed) F. M. McCULLOUGH,
Assistant Professor in Civil Engineering.

THE STRUCTURE OF "STEELCRETE" EXPANDED METAL.

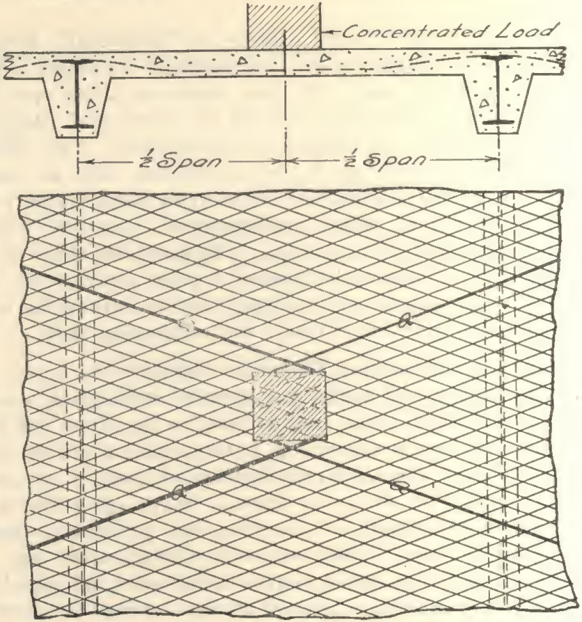
The Concentrated Load and Straight Line Reinforcement

Pages 3 and 4 show sheets of "Steelcrete" Expanded Metal in order that its structure may be best appreciated. The openings are amply large enough to permit the concrete to completely embed the steel. We have elsewhere dwelt upon the importance of the bond and the guarantee of safety offered by the use of "Steelcrete" Mesh. It is obvious that because of its structure no possibility of slipping is encountered. The quality of the steel is in keeping with its form. Of a uniform grade, in conjunction with an elastic limit of 60,000 lbs. per sq. in., it is unique in the metal fabrics for reinforcing slabs. Under a stress, the diamond shaped meshes, without slipping or any initial rearrangement, obviously introduce a compression into the concrete which at this point is in tension. The beneficial effect of this is apparent, as it aids the concrete. To this feature alone is attributed a good measure of its remarkable strength. Under severe stress these diamonds will shorten, thereby introducing a ductility into this material which is unencountered in any other fabric for reinforcing slabs.

There is still another distinctive feature to be noted. The direction of the strands is seen to be in every way. A sudden concentrated load which would prove fatal to any straight line reinforcement is amply taken care of here, as the stress will be distributed to all the adjoining strands. No better protection against the unforeseeable could be found than is offered here. Engineers are forced to design with uniformly distributed loads in the absence of any better method. These loads seldom occur. On the other hand, a heavy concentrated load, or the dropping of a heavy weight from as short a height as one foot, will produce stresses which far surpass the ordinary calculated uniform ones. When you buy reinforcement, buy that which gives you the greatest protection against that which cannot be foreseen, but which is nevertheless probable. "Steelcrete" Mesh offers a protection against shocks, internal or external explosions, and sudden dropping of heavy loads within the building. It is also a protection against the ignorance of the laborer who inserts it, a danger which cannot be too strongly guarded against in concrete work. When "Steelcrete" Expanded Metal is specified you choose a material which has stood the test of almost twenty years in actual work, and which is unsurpassed in quality, structure or efficiency at the present day.



How straight line reinforcement takes care of a concentrated load. Only three or four wires or rods commonly available for this purpose. The weakness in this respect is obvious.



How "Steelcrete" Mesh takes care of a concentrated load. All the strands within the heavy lines a-a are aiding directly to sustain it. The strands without, also are in tension, to a lesser extent.

"STEELCRETE" MESH IN FLOOR CONSTRUCTION.

The methods or systems of using "Steelcrete" Mesh as a reinforcement in floors are innumerable. The following have been selected because of their popularity, and are typical of the methods employed in the structures for which they are suggested. Variations may be adapted to suit special cases by engineers or architects.

Systems No. 1B, 1C, 1D and 2A may be used with or without the suspended ceiling as shown in System No. 1A. This method is used wherever a level ceiling is desirable. The confined air space serves to deaden the sound. It is adapted to office buildings, loft buildings, hotels, hospitals, schools, apartment houses, residences, etc. The open panel construction is adapted to warehouses, retail stores, office buildings, hotels, etc., where the panelled finish is desired or permissible.

The floors may be of any form indicated by the character of the building.

The attention of the architects is called to the "Steelcrete" beam wrapper which is required around the lower flanges of beams when concrete protection is deemed necessary. This will be found fully described elsewhere.

The tables of safe superimposed live loads will supply all the data necessary for the design of a floor system.

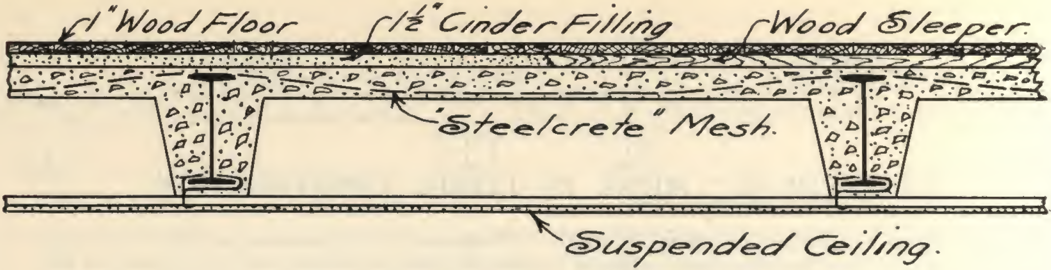


Fig. (10)—System No. 1A.

This system is a very popular form of construction. It is adapted for office buildings, hotels, apartment houses, hospitals, schools, roofs, etc. The protection of the lower flange of the supporting beams makes it an ideal fireproof construction. It may be used with or without the suspended ceiling construction as here shown.

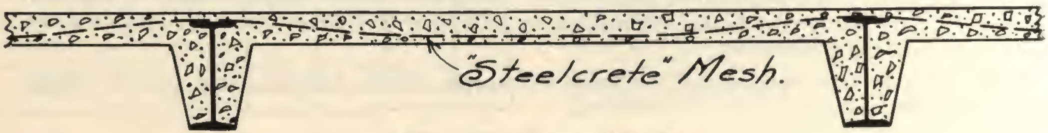


Fig. (11)—System No. 1B.

This system is similar to No. 1A. It is adapted for the same class of buildings wherever beam protection is considered unnecessary. The advantages of this system are that it is easily erected in addition to being strong and safe. The open panel construction is here shown.

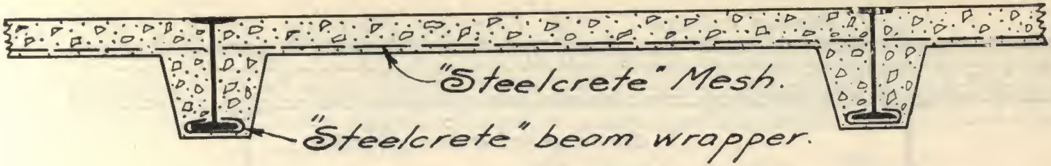


Fig. (12)—System No. 1C.

This method of construction has the same strength as systems No. 1A and No. 1B. It is adapted to the same style of buildings and is saving of headroom.

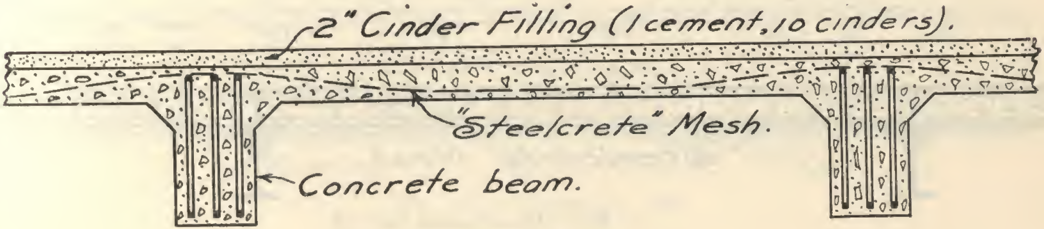


Fig. (13)—System No. 1D.

This system is similar to Nos. 1A, 1B, and 1C. It shows "Steelcrete" Mesh adapted to a reinforced concrete structure.

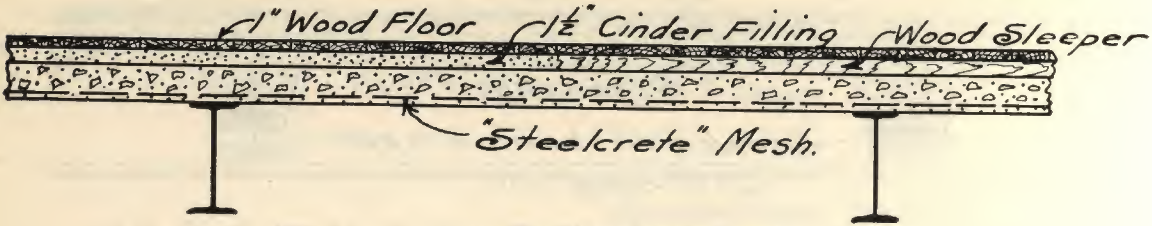


Fig. (14)—System No. 2A.

Adapted for structures where beam protection is unnecessary, such as bridge floors, stations, factory floors, purlin roofs, sidewalks, etc. The advantage of this system is the low cost of forms for erection, and the rapidity of installation.

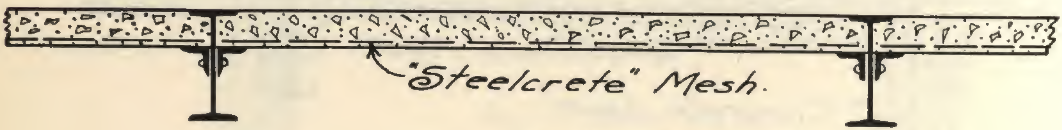


Fig. (15)—System No. 2B.

Adapted to bridge floors, sidewalks, or wherever the depth of adjoining beams makes its uneconomical to haunch the slab into the lower flange of the beam and at the same time the headroom is limited. Like system No. 2A, it is economical in forms and easy of erection.

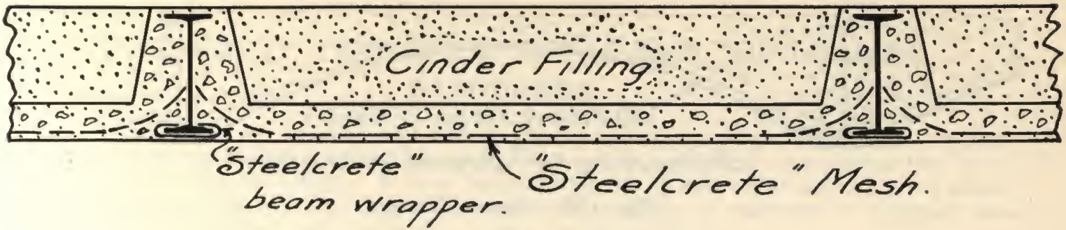


Fig. (16)—System No. 3A.

This form of construction is gaining in popularity every day. A flat ceiling is attained. It is adaptable to the first and second floor of stores where the partitions are not permanent but are subject to change at any time and the ceiling must present a flat surface. It is adapted to strictly fireproof buildings.

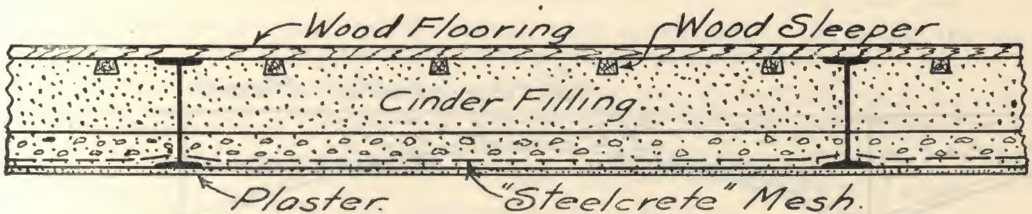


Fig. (17)—System No. 3B.

This is a modification of system No. 3A, where beam protection is not necessary. The advantage of this system, like that of system No. 2A, is that it lends itself to economy in forms and speed of erection.

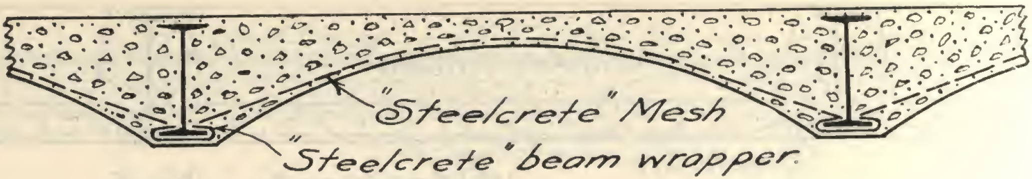


Fig. (18)—System No. 4A.

This is the strongest form of construction for floor slabs. It is adapted to warehouses, breweries, garages, press floors, etc.

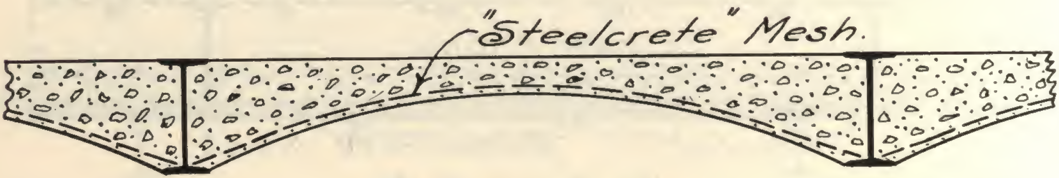


Fig. (19)—System No. 4B.

Similar to system No. 4A. Adaptable to buildings where flange protection of beams is not required. Its advantage is ease and speed of erection.

"STEELCRETE" EXPANDED METAL AND THE DECIMAL STANDARDS.

In order to permit our varying sizes and weights of material to be of most use, we have recently adopted a scale of sizes based on the decimal system, using the cross-section per ft. of width as the basis for the change. A close inspection of this system will show the great advantage offered by this scheme. The change will appeal in particular to engineers or designers who have to deal with and care only for sectional area per ft. of width.

In our new method all our standard meshes have a diamond 3 inches by 8 inches, as before. The designation of the material describes the size of the diamond, the gauge of the plate and the cross-section per ft. of width; i. e., Size 3—9—15 means that it is a 3 inch diamond, made out of No. 9 plate, having a sectional area per ft. of width of .15 sq. in. Our special meshes carried in stock have a diamond of ¾, 1½ and 2 inches in the short direction. We also make to order a 6 inch mesh, the size of the diamond being 6 inches by 16 inches. The gauge of plate used is No. 4, or nearly ¼ inch thick. Any cross-sectional area desired up to and including 0.4 sq. in. will be furnished. The width of the sheets will depend on the sectional area.

We also make a 4 inch mesh from No. 16 plate, which is unexpanded. We furnish this in any length up to 16 feet. The cross-sectional area per ft. of width is .093 sq. in.

It is well to note the special meshes, such as the ¾ inch, 1½ inch and 2 inch, are not used in concrete reinforcement except in very special cases, when unusual conditions exist.

EMBODY THIS IN YOUR SPECIFICATIONS.

The slabs shall be reinforced with "Steelcrete" Expanded Metal, size..........

(or—The slabs shall be reinforced with "Steelcrete" Expanded Metal of such a thickness of slab and size of metal as shall carry a superimposed load of .... lbs. per sq. ft. with a factor of safety of 4).

The Expanded Metal shall be laid on the forms with long way of diamond meshes extending transversely to supporting beams. Adjoining sheets shall be lapped eight inches on the end and one and a half inches on the side. They shall be wired together every three feet on the ends and every four feet on the sides.

Proportions for Mixing Concrete

Mixtures			Required for 1 cubic yard rammed concrete								
			Stone 1 in. and under, dust screened out			Stone 2½ in. and under, dust screened out			Gravel ¾ in. and under		
Cement	Sand	Stone	Cement, bbls.	Sand, cu. yds.	Stone, cu. yds.	Cement, bbls.	Sand, cu. yds.	Stone, cu. yds.	Cement, bbls.	Sand, cu. yds.	Gravel, cu. yds.
1	1.0	2.0	2.57	0.39	0.78	2.63	0.40	0.80	2.30	0.35	0.74
1	1.0	2.5	2.29	0.35	0.70	2.34	0.36	0.89	2.10	0.32	0.80
1	1.0	3.0	2.06	0.31	0.94	2.10	0.32	0.96	1.89	0.29	0.86
1	1.0	3.5	1.84	0.28	0.98	1.88	0.29	1.00	1.71	0.26	0.91
1	1.5	2.5	2.05	0.47	0.78	2.09	0.48	0.80	1.83	0.42	0.73
1	1.5	3.0	1.85	0.42	0.84	1.90	0.43	0.87	1.71	0.39	0.78
1	1.5	3.5	1.72	0.39	0.91	1.74	0.40	0.93	1.57	0.36	0.83
1	1.5	4.0	1.57	0.36	0.96	1.61	0.37	0.98	1.46	0.33	0.88
1	1.5	4.5	1.43	0.33	0.98	1.46	0.33	1.00	1.34	0.31	0.91
1	2.0	3.0	1.70	0.52	0.77	1.73	0.53	0.79	1.54	0.47	0.73
1	2.0	3.5	1.57	0.48	0.83	1.61	0.49	0.85	1.44	0.44	0.77
1	2.0	4.0	1.46	0.44	0.89	1.48	0.45	0.90	1.34	0.41	0.81
1	2.0	4.5	1.36	0.42	0.93	1.38	0.42	0.95	1.26	0.38	0.86
1	2.0	5.0	1.27	0.39	0.97	1.29	0.39	0.98	1.17	0.36	0.89
1	2.5	3.5	1.45	0.55	0.77	1.48	0.56	0.79	1.32	0.50	0.70
1	2.5	4.0	1.35	0.52	0.82	1.38	0.53	0.84	1.24	0.47	0.75
1	2.5	4.5	1.27	0.48	0.87	1.29	0.49	0.88	1.16	0.44	0.80
1	2.5	5.0	1.19	0.46	0.91	1.21	0.46	0.92	1.10	0.42	0.83
1	2.5	5.5	1.13	0.43	0.94	1.15	0.44	0.96	1.03	0.39	0.86
1	2.5	6.0	1.07	0.41	0.97	1.07	0.41	0.98	0.98	0.37	0.89
1	3.0	4.0	1.26	0.58	0.77	1.28	0.58	0.78	1.15	0.52	0.72
1	3.0	4.5	1.18	0.54	0.81	1.20	0.55	0.82	1.09	0.50	0.75
1	3.0	5.0	1.11	0.51	0.85	1.14	0.52	0.87	1.03	0.47	0.78
1	3.0	5.5	1.06	0.48	0.89	1.07	0.49	0.90	0.97	0.44	0.81
1	3.0	6.0	1.01	0.46	0.92	1.02	0.47	0.93	0.92	0.42	0.84
1	3.0	6.5	0.96	0.44	0.95	0.98	0.44	0.96	0.88	0.40	0.87
1	3.0	7.0	0.91	0.42	0.97	0.92	0.42	0.98	0.84	0.38	0.89
1	3.5	5.0	1.05	0.56	0.80	1.07	0.57	0.82	0.96	0.50	0.76
1	3.5	5.5	1.00	0.53	0.84	1.02	0.54	0.85	0.92	0.48	0.78
1	3.5	6.0	0.95	0.50	0.87	0.97	0.51	0.89	0.88	0.46	0.80
1	3.5	6.5	0.92	0.49	0.91	0.93	0.49	0.92	0.83	0.44	0.82
1	3.5	7.0	0.87	0.47	0.93	0.89	0.47	0.95	0.80	0.43	0.85
1	3.5	7.5	0.84	0.45	0.96	0.86	0.45	0.98	0.76	0.41	0.87
1	3.5	8.0	0.80	0.42	0.97	0.82	0.43	1.01	0.73	0.39	0.89
1	4.0	6.0	0.90	0.55	0.82	0.92	0.56	0.84	0.83	0.51	0.77
1	4.0	6.5	0.87	0.53	0.85	0.88	0.53	0.87	0.80	0.49	0.79
1	4.0	7.0	0.83	0.51	0.89	0.84	0.51	0.90	0.77	0.47	0.81
1	4.0	7.5	0.80	0.49	0.91	0.81	0.50	0.93	0.73	0.44	0.83
1	4.0	8.0	0.77	0.47	0.93	0.78	0.48	0.95	0.71	0.43	0.86
1	4.0	8.5	0.74	0.45	0.95	0.76	0.46	0.98	0.68	0.42	0.88
1	4.0	9.0	0.71	0.43	0.97	0.73	0.44	1.01	0.65	0.40	0.89

Decimal Standards for "Steelcrete" Expanded Metal.

Designation of Mesh	Size of Mesh: Width of Diamond	Size of Mesh: Length of Diamond	Section in sq. in. per ft of width	Wt. per square foot in lbs.	Number of sheets in a bundle	Size of Standard sheets	Number of sq. ft. in a bundle	Wt. per bundle in lbs
3-13-075	3″	8″	.075	.27	10	6′0″ x 8′0″ 6′0″ x 12′0″	480 720	129.6# 194.4
3-13-10	3″	8″	.10	.37	7	6′9″ x 8′0″ 6′9″ x 12′0″	378 567	139.9 209.8
3-13-125	3″	8″	.125	.46	7	5′3″ x 8′0″ 5′3″ x 12′0″	294 441	135.2 202.9
3-9-15	3″	8″	.15	.55	5	7′0″ x 8′0″ 7′0″ x 12′0″	280 420	154.0 231.0
3-9-20	3″	8″	.20	.73	5	5′3″ x 8′0″ 5′3″ x 12′0″	210 315	153.3 230.0
3-9-25	3″	8″	.25	.92	5	4′0″ x 8′0″ 4′0″ x 12′0″	160 240	147.2 220.8
3-9-30	3″	8″	.30	1.10	2	7′0″ x 8′0″ 7′0″ x 12′0″	112 168	123.2 184.8
3-9-35	3″	8″	.35	1.28	2	6′0″ x 8′0″ 6′0″ x 12′0″	96 144	122.9 184.3
3-6-40	3″	8″	.40	1.46	2	7′0″ x 8′0″ 7′0″ x 12′0″	112 168	163.5 245.3
3-6-45	3″	8″	.45	1.65	2	6′3″ x 8′0″ 6′3″ x 12′0″	100 150	165.0 247.5
3-6-50	3″	8″	.50	1.83	2	5′9″ x 8′0″ 5′9″ x 12′0″	92 138	168.4 252.5
3-6-55	3″	8″	.55	2.01	2	5′3″ x 8′0″ 5′3″ x 12′0″	84 126	168.8 253.3
3-6-60	3″	8″	.60	2.19	2	4′9″ x 8′0″ 4′9″ x 12′0″	76 114	166.4 249.7

"Steelcrete" Special Meshes.

¾-13-25	.95″	2″	.225	.80	5	6′0″ x 8′0″	240	192.0
1½-13-20	1.36″	3″	.181	.60	5	4′0″ x 8′0″	160	96.0
2-13-15	1.82″	4″	.15	.50	5	5′0″ x 8′0″	200	100.0

INTRODUCTION TO TABLES.

The tables for stone or gravel concrete are based on a unit stress in the steel of 18,500 lbs. per sq. in., and on the concrete of 750 lbs. per sq. in. This stress in the steel is taken because it possesses a factor of safety of three on the elastic limit. The stress in the concrete is for good stone concrete of a mixture not weaker than 1:2:5. These stresses are commonly governed by building laws or specifications of engineers. The variation is so great that it would be impossible to give tables to govern all cases. We have on hand, and in preparation, tables governed by other unit stresses to conform with building laws of our large cities. We will be glad to forward these on request.

The loads given in the tables are the safe live loads in lbs. per sq. ft. In every case the weight of the slab has been deducted. The weights of slab assumed are as follows:—

	Slab Thickness:	3″	4″	5″	6″	7″	8″	9″	10″	11″	12″	13″	14″	15″	16″.
Weight of Slab	Stone:	37	50	62	75	87	100	112	125	137	150	162	175	187	200 lbs.
	Cinder:	29	38	48	58	67	77	86	96	105	115	125	134	144	153 lbs.

The depth from the bottom of the slab to the center of the steel is assumed as:-

For 3-13-075 to 3-6-50 inclusive, ¾″
" 3-6-55 and 3-6-60 1″
" 3-6-75 and 3-6-100 1¼″

"Steelcrete" Mesh Slab Tables

for use with

Gravel or Stone Concrete.

Maximum Stress in Steel = 18,500 lbs. per sq. inch.
Maximum Stress in Concrete = 750 lbs. per sq. inch.

Maximum Bending Moment = $M = \frac{1}{12} w l^2$.
where
w = total load per sq. ft.
l = center to center span.

3-13-075 "Steelcrete" Expanded Metal. Area = 0.075 sq. in. per ft. of width.														Unit Stresses lbs. per sq. in.	
Slab.	Span.														
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"				Concrete	Steel.
3"	143	105	78	58	43	31	22							455	18,500
3½	178	131	98	73	55	40	29	19						405	"
4	214	158	119	89	67	50	36	25						370	"
4½	250	185	140	106	80	60	44	31	20					340	"
5	286	213	161	122	93	70	52	37	25					325	"
6	357	266	201	153	117	89	66	48	33					290	"
7	429	321	243	186	142	109	82	60	42	15				260	"
8	500	374	284	218	167	127	96	71	50	19				240	"
9	574	430	327	251	193	148	112	83	60	24				220	"
10	646	484	369	283	218	167	127	94	68	27				210	"
11	719	539	411	316	244	187	143	107	77	32				200	"
12"	792	594	453	348	269	207	158	118	85	36				190	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 750\#/\text{sq. in}$ $M = \frac{1}{12} w l^2$ Max. $f_s = 18{,}500\#/\text{sq. in.}$

3-9-25 "Steelcrete" Expanded Metal. Area = 0.250 sq. in. per ft. of width.

Slab.	Span.																			Unit Stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
3"	428	330	261	209	170	139	115	95	79	55	37	24								750	15,100
3½	608	471	373	301	246	203	169	141	119	85	60	42	28							"	17,200
4	787	612	486	393	322	267	223	188	159	115	84	61	43	29	18					730	18,500
4½	916	712	566	458	376	312	262	221	187	136	100	73	52	36	23					675	"
5	1048	816	649	526	431	358	301	254	216	157	116	85	61	43	29					630	"
6	1309	1019	811	657	540	449	377	319	271	198	146	108	79	56	38	23				560	"
7	1571	1223	974	790	650	541	455	385	328	241	178	132	97	70	48	31	17			505	"
8	1834	1428	1137	923	760	632	531	450	384	282	209	156	115	83	58	38	21			460	"
9	2099	1637	1304	1058	872	726	610	518	441	325	242	181	134	98	69	45	26			430	"
10	2364	1840	1467	1191	980	817	687	583	497	366	273	204	151	111	78	52	30			405	"
11	2631	2051	1633	1325	1092	910	766	649	555	409	305	229	170	125	89	60	36			385	"
12"	2898	2258	1800	1461	1205	1004	845	717	612	452	338	253	189	138	99	67	40	19		360	"

3-9-30 "Steelcrete" Expanded Metal. Area = 0.300 sq. in. per ft. of width.

Slab.	Span.																			Unit Stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
3"	456	353	279	224	182	150	124	103	86	61	42	28								750	13,500
3½	645	500	397	320	262	217	181	152	128	92	66	47	33							"	15,300
4	866	674	536	435	357	297	249	211	179	131	97	71	52	37	25					"	17,000
4½	1102	858	685	556	458	382	322	273	233	173	129	97	73	54	39	26				"	18,500
5	1259	982	784	637	526	438	369	314	269	199	149	113	85	63	46	32	21			700	"
6	1574	1227	980	797	658	549	463	394	337	251	189	143	108	81	60	42	28			620	"
7	1891	1475	1179	959	792	662	559	475	408	304	229	174	133	100	74	54	37	23		560	"
8	2205	1721	1375	1119	924	773	653	556	476	355	269	205	156	118	88	64	44	28		515	"
9	2526	1970	1576	1283	1060	886	749	638	547	409	310	237	181	138	103	76	53	34		475	"
10	2842	2217	1774	1444	1193	998	844	719	617	461	350	267	205	156	117	86	60	39	22	445	"
11	3163	2472	1974	1608	1329	1113	941	802	688	515	391	299	230	175	132	98	69	46	26	420	"
12"	3488	2722	2179	1773	1466	1226	1037	884	759	568	432	331	254	194	147	109	77	51	30	400	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 750\#/\text{sq. in.}$ $M = \frac{1}{12} w l^2.$ Max. $f_s = 18{,}500\#/\text{sq. in.}$

3-9-35 "Steelcrete" Expanded Metal. Area = 0.350 sq. in. per ft. of width

Slab	Span.																			Unit Stresses. lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
3"	480	372	294	236	193	159	132	110	92	65	46	31	20							750	12,200
3½	682	529	420	340	278	231	193	162	137	99	72	52	37	25						"	13,900
4	908	707	563	457	376	313	263	222	190	139	103	77	56	41	28					"	15,400
4½	1166	910	726	590	488	407	343	292	250	185	140	106	80	60	44	31	20			"	16,900
5	1446	1129	903	736	608	509	430	367	315	236	179	137	106	81	61	45	32	22		"	18,200
6	1835	1434	1148	936	775	649	549	469	403	302	231	178	137	106	81	61	44	31	19	675	18,500
7	2203	1723	1379	1125	931	781	661	565	486	366	280	216	168	130	100	76	56	40	26	610	"
8	2576	2013	1613	1315	1089	913	774	661	569	429	328	254	197	153	118	90	67	48	32	560	"
9	2948	2306	1846	1506	1248	1047	887	758	653	492	378	292	228	178	138	106	79	57	39	520	"
10	3320	2596	2079	1697	1406	1179	1000	855	736	556	427	330	258	201	156	120	90	66	45	490	"
11	3694	2891	2314	1890	1566	1313	1114	953	821	620	476	369	289	226	176	136	103	75	52	460	"
12"	4070	3185	2550	2082	1726	1449	1229	1050	906	684	526	408	319	250	195	150	114	84	58	440	"

3-6-40 "Steelcrete" Expanded Metal. Area = 0.400 sq. in. per ft of width.

Slab	Span																			Unit Stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
3"	503	389	308	248	203	167	139	117	98	70	49	34	23							750	11,300
3½	713	554	441	356	292	243	203	171	145	106	77	56	40	28						"	12,800
4	954	743	592	481	396	330	278	236	201	148	111	83	62	45	32	21				"	14,200
4½	1219	952	760	619	511	427	361	307	263	196	148	113	86	65	48	35	24			"	15,500
5	1517	1185	948	773	640	536	454	387	333	250	191	147	113	88	67	50	37	25		"	16,800
6	2090	1636	1311	1070	888	745	632	541	467	353	271	211	166	130	102	79	60	45	32	730	18,500
7	2513	1968	1578	1289	1069	898	763	653	563	427	329	257	202	159	125	98	76	57	41	660	"
8	2938	2300	1844	1506	1250	1050	892	764	660	500	386	302	238	188	148	116	90	68	50	610	"
9	3368	2638	2116	1728	1434	1206	1024	878	758	576	444	348	275	217	172	135	105	81	60	565	"
10	3795	2970	2383	1946	1615	1359	1154	989	855	649	501	393	310	246	195	153	120	92	69	530	"
11	4218	3303	2652	2165	1798	1512	1285	1101	951	723	559	439	347	275	218	173	135	104	78	495	"
12"	4650	3640	2920	2388	1981	1666	1416	1214	1050	798	618	484	383	304	242	191	150	116	87	470	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 750$ #/sq. in. $M = \frac{1}{12} w l^2$. Max. $f_s = 18{,}500$ #/sq. in.

3-6-45 "Steelcrete" Expanded Metal. Area = 0.450 sq. in. per ft. of width

Slab.	Span.																			Unit Stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
3"	521	404	320	258	211	174	145	122	102	73	52	37	25							750	10,400
3½	738	574	457	370	304	253	212	179	152	111	81	59	43	30	20					"	11,800
4	991	772	616	501	413	344	290	246	210	156	117	88	66	49	35	24				"	13,200
4½	1268	990	792	644	532	446	376	321	275	206	156	119	91	69	52	38	27			"	14,400
5	1574	1231	985	804	666	558	472	403	347	261	200	154	120	93	72	54	40	29	19	"	15,600
6	2255	1766	1417	1158	961	808	686	588	508	385	298	233	184	146	115	91	71	54	40	"	17,800
7	2823	2213	1776	1453	1207	1016	864	741	641	488	379	298	236	189	151	120	95	74	57	705	18,500
8	3305	2590	2080	1700	1413	1189	1011	868	751	572	444	350	278	222	178	142	113	88	68	650	"
9	3783	2963	2378	1948	1618	1362	1159	995	861	657	511	402	320	257	206	165	131	103	80	605	"
10	4255	3340	2680	2194	1823	1535	1306	1121	971	741	577	455	362	290	233	187	149	118	91	565	"
11	4743	3718	2983	2443	2031	1711	1456	1251	1083	827	643	508	405	325	261	210	168	133	104	530	"
12"	5225	4095	3290	2692	2240	1885	1605	1379	1194	911	710	560	447	359	289	232	186	148	115	505	"

3-6-50 "Steelcrete" Expanded Metal. Area = 0.500 sq. in. per ft. of width.

Slab	Span.																			Unit Stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
4"	1026	800	638	519	428	358	302	256	219	163	122	92	70	52	38	27				750	12,300
4½	1320	1030	824	672	556	465	393	335	288	216	164	126	97	74	56	42	30			"	13,500
5	1628	1273	1019	832	689	578	490	419	360	272	208	161	126	98	76	58	44	32	21	"	14,600
6	2340	1833	1471	1203	999	840	714	612	529	402	311	244	193	154	122	97	76	59	44	"	16,700
7	3131	2453	1973	1614	1342	1131	963	828	717	548	427	338	270	217	176	142	114	91	72	"	18,500
8	3660	2870	2305	1888	1570	1323	1127	969	840	642	502	397	318	256	207	167	135	108	86	690	"
9	4193	3288	2643	2166	1801	1518	1294	1112	964	739	577	457	366	296	239	194	157	126	101	640	"
10	4725	3705	2977	2438	2029	1710	1458	1254	1087	833	651	516	413	334	271	220	178	143	114	600	"
11	5263	4128	3321	2721	2263	1908	1627	1399	1213	929	727	577	463	374	304	247	200	162	130	565	"
12"	5790	4545	3650	2991	2490	2100	1790	1540	1335	1024	801	635	510	412	335	273	221	179	143	540	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 750\#/\text{sq. in.}$ $M = \frac{1}{12} w l^2$. Max. $f_s = 18{,}500\#/\text{sq. in.}$

3-6-55 "Steelcrete" Expanded Metal. Area = 0.550 sq. in. per ft. of width.

Slab	Span 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Unit Stresses lbs. per sq. in. Concrete	Steel.
4"	918	715	570	462	380	317	266	225	192	141	105	78	58	42	29	19				750	11,000
4½	1199	936	748	608	502	419	354	301	258	192	145	110	83	63	46	33	22			"	12,100
5	1510	1180	945	770	637	534	452	385	331	249	190	146	113	87	66	50	36	25		"	13,200
6	2215	1735	1391	1136	943	793	673	577	498	378	292	228	180	142	112	88	68	52	38	"	15,200
7	3028	2373	1906	1560	1297	1092	930	799	691	528	411	325	259	208	167	134	108	85	67	"	17,100
8	3870	3035	2440	1999	1663	1402	1196	1028	892	684	535	424	341	276	224	182	148	120	96	740	18,500
9	4448	3493	2809	2303	1918	1617	1378	1186	1029	790	618	492	395	320	261	213	173	141	113	690	"
10	5040	3955	3180	2607	2173	1831	1560	1344	1166	895	701	558	449	364	297	242	198	161	130	640	"
11	5628	4418	3553	2913	2424	2046	1746	1503	1304	1001	785	625	504	409	334	273	223	182	148	605	"
12"	6215	4880	3925	3220	2680	2260	1930	1660	1441	1108	869	692	558	453	370	303	248	202	165	575	"

3-6-60 "Steelcrete" Expanded Metal. Area = 0.600 sq. in. per ft. of width

Slab	Span 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Unit Stresses lbs. per sq. in. Concrete	Steel.
4"	941	734	584	474	391	325	274	232	198	146	109	81	60	44	31	21				750	10,400
4½	1235	964	770	627	518	433	366	311	267	199	151	115	88	66	49	36	25			"	11,500
5	1553	1214	972	793	656	550	466	397	342	257	197	152	117	91	70	53	39	27	18	"	12,500
6	2278	1785	1431	1170	971	817	693	595	513	390	302	236	187	148	117	92	72	55	41	"	14,400
7	3111	2441	1961	1604	1334	1124	957	823	713	545	425	336	268	216	174	140	113	90	71	"	16,100
8	4045	3175	2552	2091	1742	1470	1253	1079	936	719	563	448	361	292	238	195	159	129	105	"	17,800
9	4848	3803	3058	2508	2088	1765	1507	1298	1127	868	681	543	439	357	292	240	198	162	133	720	18,500
10	5480	4305	3465	2840	2365	1997	1705	1470	1277	983	772	616	498	406	333	274	225	185	152	675	"
11	6128	4813	3873	3175	2646	2234	1908	1645	1428	1100	865	691	559	456	374	308	255	210	172	635	"
12"	6770	5320	4280	3510	2925	2470	2110	1820	1580	1217	957	765	619	506	415	342	283	233	192	600	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 750\,\#/\text{sq. in.}$ $M = \frac{1}{12} w l^2$. Max. $f_s = 18{,}500\,\#/\text{sq. in.}$

3-6-75 "Steelcrete" Expanded Metal. Area = 0.750 sq. in. per ft. of width.																				Unit Stresses lbs. per sq. in.	
Slab.	Span.																				
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
5"	1486	1162	930	757	626	524	444	378	325	244	186	143	110	85	64	48	35	24		750	10,400
6	2238	1754	1406	1149	953	801	681	583	503	382	295	231	182	144	114	90	70	53	39	"	12,100
7	3118	2443	1963	1608	1337	1126	959	824	714	546	425	337	269	216	175	141	113	90	71	"	13,700
8	4090	3208	2580	2113	1760	1485	1266	1090	946	727	570	454	365	296	242	198	162	132	106	"	15,100
9	5173	4068	3273	2686	2238	1889	1614	1391	1210	932	734	587	476	389	320	264	218	181	149	"	16,500
10	6350	4995	4020	3303	2754	2327	1990	1718	1495	1154	911	731	595	488	403	336	280	234	195	"	17,800
11	7403	5823	4688	3853	3215	2718	2325	2008	1748	1353	1069	860	701	577	479	399	334	280	235	730	18,500
12	8210	6460	5205	4275	3568	3018	2580	2229	1940	1502	1188	955	779	642	533	444	372	313	263	690	"
13	9013	7088	5713	4693	3918	3313	2836	2448	2132	1652	1307	1051	857	706	588	490	412	346	291	655	"
14	9825	7725	6225	5115	4270	3613	3088	2668	2325	1799	1425	1146	935	771	641	536	450	379	319	630	"
15	10633	8363	6733	5533	4623	3908	3343	2888	2515	1951	1543	1243	1014	836	696	582	489	411	347	600	"
16"	11440	9000	7250	5960	4975	4210	3600	3110	2710	2100	1662	1341	1093	902	750	628	528	444	375	580	"

3-6-100 "Steelcrete" Expanded Metal. Area = 1.000 sq. in. per ft. of width.																				Unit Stresses lbs. per sq. in.	
Slab.	Span.																				
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
5"	1613	1262	1010	824	683	573	486	415	357	269	206	160	124	97	75	57	43	31	21	750	8,600
6	2447	1918	1540	1259	1046	881	749	643	556	423	329	259	205	164	131	104	83	65	50	"	10,100
7	3413	2681	2153	1764	1468	1239	1056	909	789	605	473	376	302	244	199	162	132	107	86	"	11,400
8	4485	3520	2835	2325	1938	1636	1398	1204	1046	806	634	506	409	334	274	226	187	154	126	"	12,600
9	5678	4463	3593	2950	2463	2080	1778	1534	1336	1032	815	654	531	436	361	300	250	209	174	"	13,800
10	6970	5480	4415	3627	3030	2564	2193	1893	1649	1276	1010	813	663	547	454	379	319	268	225	"	14,800
11	8363	6583	5303	4363	3643	3083	2642	2282	1990	1543	1223	987	808	668	557	467	394	334	283	"	15,900
12	9900	7795	6285	5170	4320	3660	3132	2710	2363	1835	1459	1179	966	802	671	565	478	407	346	"	16,900
13	11478	9038	7288	5993	5008	4248	3638	3148	2748	2138	1700	1377	1131	940	788	666	566	482	413	"	17,900
14	12955	10195	8235	6795	5665	4800	4115	3565	3110	2420	1925	1561	1284	1069	897	759	646	552	474	740	18,500
15	14023	11043	8913	7333	6133	5193	4453	3858	3368	2622	2087	1693	1392	1159	973	824	702	600	515	710	"
16"	15110	11900	9600	7900	6605	5600	4800	4155	3630	2825	2250	1825	1501	1250	1050	889	757	648	556	680.	"

The Consolidated Expanded Metal Co's.

PITTSBURGH NEW YORK

Steelcrete
TRADE MARK
REGISTERED

NEW YORK, May 1, 19

We are herewith enclosing additional tables for stone concrete, showing the safe working loads for "Steelcrete" Expanded Metal, based on the following stresses:-

Concrete 650 lbs. per sq. in.
Steel 16,000 " " " "

The Building Department of the Borough of Manhattan at present allows the above stresses in stone concrete, using a bending moment of $\frac{Wl}{10}$ for continuous spans and $\frac{Wl}{8}$ for simple spans. While you will notice the enclosed tables are figured on a bending moment of $\frac{Wl}{12}$; the safe loads figured on a bending moment of $\frac{Wl}{8}$ or $\frac{Wl}{10}$ may be found by taking $\frac{8}{12}$ or $\frac{10}{12}$ of the loads given in the tables, after adding the weight of the slab.

Steelcrete
TRADE MARK
REGISTERED

For example: Find the safe live load which a 4 inch slab, reinforced with 3-13-10 ''Steelcrete'' Expanded Metal, will carry on a simple span of 6 feet, with the unit stress in the concrete and steel 650 and 16000 lbs. per sq. in., respectively.

Looking in the table, we find for the above conditions with a bending moment of $\frac{Wl}{12}$, the safe live load is 84 lbs. per sq. ft. Adding the weight of a 4 inch slab, 50 lbs., gives a safe total load of 134 lbs. Then, $\frac{8}{12}$ of 134 lbs. gives 89 lbs. safe total load, and by deducting the weight of the slab, gives a safe live load of 39 lbs. per sq. ft.

Kindly insert these tables in your ''Steelcrete'' Expanded Metal Catalog after page 42.

Yours truly,

THE CONSOLIDATED EXPANDED METAL CO'S.

"Steelcrete" Mesh Slab Tables

for use with

Gravel or Stone Concrete.

Maximum Stress in Steel = 16,000 lbs. per sq. inch.
Maximum Stress in Concrete = 650 lbs. per sq. inch.

Maximum Bending Moment $= M = \frac{1}{12} w l^2$.
where
w = total load per sq. ft.
l = center to center span.

3-13-075 "Steelcrete" Expanded Metal. Area = 0.075 sq. in. per ft. of width.

Slab	Span. 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	Unit stresses lbs. per sq. in. Concrete	Steel.
3"	119	86	63	45	32	22				395	16,000
3½	148	108	79	58	41	29	19			350	"
4	178	130	96	71	51	36	25			320	"
4½	208	153	113	84	62	44	30	19		300	"
5	239	176	131	97	72	52	36	24		280	"
6	299	220	164	123	91	66	47	31		250	"
7	360	266	199	149	112	82	59	40	25	225	"
8	420	311	233	175	131	97	70	48	30	210	"
9	482	357	268	202	152	113	82	57	36	190	"
10	542	402	302	228	171	128	93	65	42	180	"
11	603	448	337	255	192	143	105	74	48	170	"
12"	664	493	371	281	212	159	116	82	54	165	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 650^{\#}/\text{sq. in.}$ $M = \frac{1}{12} w l^2.$ Max. $f_s = 16{,}000^{\#}/\text{sq. in.}$

3-13-10 "Steelcrete" Expanded Metal. Area = 0.100 sq. in. per ft. of width.

Slab	Span												Unit stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"		Concrete	Steel.
3"	169	126	95	72	55	41	30	22					465	16,000
3½	210	156	118	90	69	52	39	28					415	"
4	251	188	143	109	84	64	48	36	25				375	"
4½	293	220	168	129	99	76	58	43	31				345	"
5	335	252	192	148	115	88	68	51	37				325	"
6	419	315	241	186	144	112	86	65	48	23			290	"
7	504	380	291	226	176	137	106	81	61	30			265	"
8	589	444	341	264	206	161	125	96	72	36			245	"
9	674	510	391	304	237	186	145	112	85	43			225	"
10	759	573	440	342	268	210	163	126	96	50			210	"
11	845	639	492	383	299	235	184	142	108	57	20		200	"
12"	930	704	541	421	330	259	203	157	120	63	23		190	"

3-13-125 "Steelcrete" Expanded Metal. Area = 0.125 sq. in. per ft. of width.

Slab	Span												Unit stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	Concrete	Steel.
3"	218	164	126	98	76	60	46	36	27				525	16,000
3½	270	204	157	122	96	75	59	45	35				470	"
4	323	245	189	147	116	91	72	56	43	24			430	"
4½	377	286	221	173	137	108	85	67	52	30			390	"
5	431	327	253	199	157	125	99	78	61	35			365	"
6	538	410	317	249	198	157	125	99	78	46	23		325	"
7	647	493	383	301	239	191	153	122	97	58	30		300	"
8	755	575	447	352	280	224	179	143	114	69	37		275	"
9	865	660	513	404	322	258	207	166	132	81	44		260	"
10	972	743	578	456	363	291	233	187	149	92	51	20	240	"
11	1083	827	644	508	405	325	261	210	168	104	58	24	225	"
12"	1193	911	710	560	447	358	289	232	186	115	65	28	215	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft

Max. $f_c = 650^{\#}/$sq. in. $M = \frac{1}{12} w l^2$. Max. $f_s = 16{,}000^{\#}/$sq. in.

3-9-15 "Steelcrete" Expanded Metal. Area = 0.150 sq. in. per ft. of width.															Unit stresses lbs. per sq. in.	
Slab.	Span.															
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"			Concrete	Steel.
3"	266	202	157	123	98	78	62	49	39	23						585	16,000
3½	330	251	195	154	122	98	78	62	50	30						520	"
4	395	302	235	185	148	119	95	77	61	38	21					475	"
4½	460	352	274	217	173	140	113	91	73	46	26					435	"
5	526	403	315	249	200	161	130	105	85	54	32					405	"
6	657	503	393	312	250	202	164	133	108	70	42	22				360	"
7	790	605	474	377	303	245	199	162	132	86	53	29				325	"
8	922	708	554	440	354	287	234	191	155	102	63	35				305	"
9	1056	810	636	506	407	330	269	220	180	119	75	42				285	"
10	1188	913	715	570	459	372	304	249	204	134	85	49	21			265	"
11	1322	1015	797	635	511	415	339	278	228	151	96	56	25			250	"
12"	1455	1117	877	699	563	458	374	306	252	167	107	62	28			240	"

3-9-20 "Steelcrete" Expanded Metal. Area = 0.200 sq. in. per ft. of width.															Unit stresses lbs. per sq. in.	
Slab.	Span															
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	Concrete	Steel.
3"	339	260	204	162	130	105	86	70	57	37	23					650	15,100
3½	448	345	271	216	175	142	117	96	79	53	35	21				605	16,000
4	536	413	325	260	211	172	142	117	97	66	44	28				555	"
4½	625	482	380	304	247	202	167	138	114	79	53	34	20			515	"
5	714	551	435	348	283	232	192	159	132	91	62	41	24			480	"
6	891	688	543	436	354	291	240	200	166	116	80	53	32			425	"
7	1070	828	654	525	427	351	291	242	202	142	98	66	42	23		385	"
8	1250	966	764	614	500	411	341	284	238	167	116	79	50	28		355	"
9	1431	1107	876	704	574	472	392	327	274	193	135	92	59	34		330	"
10	1611	1246	985	793	647	532	442	369	309	218	153	104	68	39		310	"
11	1793	1387	1098	883	721	594	493	412	346	244	172	118	77	46	21	295	"
12"	1972	1526	1208	972	793	654	543	454	381	269	190	131	86	51	23	280	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs per sq. ft.

Max. $f_c = 650^{\#}/\text{sq. in.}$ $M = \frac{1}{12} w l^2$ Max. $f_s = 16{,}000^{\#}/\text{sq. in.}$

3-9-25 "Steelcrete" Expanded Metal. Area = 0.250 sq. in. per ft. of width.

Slab	Span																Unit stresses. lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	Concrete	Steel.
3"	366	281	221	176	142	116	95	78	64	43	28						650	13,100
3½	521	403	318	255	208	170	141	117	97	68	47	31	19				"	14,900
4	675	523	414	333	272	224	187	156	131	93	66	46	31	19			635	16,000
4½	786	609	483	389	318	263	219	184	155	110	79	55	38	24			585	"
5	898	697	553	446	365	302	252	211	178	128	92	65	45	29			550	"
6	1121	871	691	558	457	378	316	265	224	161	117	83	58	38	23		485	"
7	1347	1046	831	671	551	456	381	321	272	196	142	103	72	49	30		435	"
8	1572	1221	970	785	643	533	446	376	318	230	168	121	86	58	36	19	400	"
9	1800	1399	1112	900	740	613	513	432	366	266	194	141	100	69	44	24	370	"
10	2025	1575	1252	1013	832	690	578	487	413	300	219	160	114	79	51	28	350	"
11	2254	1753	1394	1128	926	769	644	543	461	335	246	179	129	89	58	33	330	"
12"	2485	1931	1536	1244	1021	848	710	600	509	371	272	198	143	99	65	37	320	"

3-9-30 "Steelcrete" Expanded Metal. Area = 0.300 sq. in. per ft. of width.

Slab	Span																		Unit stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	Concrete	Steel
3"	391	301	237	189	153	125	103	85	71	48	32	20							650	11,700
3½	554	428	339	272	221	182	151	126	105	74	52	35	22						"	13,300
4	744	578	458	370	303	251	210	176	149	107	77	55	38	25					"	14,700
4½	945	736	585	474	389	323	271	229	194	142	104	76	55	39	26				"	16,000
5	1080	841	669	542	446	371	311	263	224	164	121	89	65	46	31	19			600	"
6	1350	1051	837	679	559	465	390	331	281	207	153	113	83	60	41	26			535	"
7	1623	1263	1007	817	673	561	471	399	341	251	187	139	103	75	53	35	20		485	"
8	1893	1475	1176	955	786	655	551	467	398	294	219	164	122	89	63	42	25		445	"
9	2168	1691	1348	1094	902	752	633	537	458	339	253	190	142	104	74	50	31		410	"
10	2443	1903	1517	1233	1015	847	713	605	517	382	286	214	160	118	84	58	35		385	"
11	2722	2122	1692	1374	1133	946	796	676	578	428	320	241	181	134	96	66	42	21	365	"
12"	2995	2335	1862	1514	1248	1041	877	745	636	472	354	266	199	148	107	74	47	24	345	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 650\,\#/\text{sq. in}$ $\qquad M = \frac{1}{12} w l^2.$ $\qquad$ Max. $f_s = 16{,}000\,\#/\text{sq. in.}$

3-9-35 "Steelcrete" Expanded Metal. Area = 0.350 sq. in. per ft. of width.

Slab.	Span.																			Unit stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
3"	412	317	250	200	162	133	109	91	75	52	35	22								650	10,600
3½	586	453	359	289	236	194	162	135	113	80	57	39	26							"	12,000
4	780	606	482	389	319	264	221	186	158	114	83	60	42	29						"	13,400
4½	1005	784	624	506	416	346	291	246	210	154	114	84	62	45	31	20				"	14,600
5	1245	971	775	630	519	433	365	310	265	196	147	111	83	62	45	31	20			"	15,800
6	1577	1230	982	799	659	551	464	395	338	251	189	143	109	81	60	42	28			585	16,000
7	1895	1479	1181	961	794	664	561	477	409	305	230	175	133	101	75	54	37	23		525	"
8	2213	1728	1381	1123	929	776	656	558	478	357	270	206	157	119	89	65	45	28		485	"
9	2532	1978	1580	1287	1063	889	752	640	549	410	311	238	182	138	104	76	53	34	19	450	"
10	2854	2226	1781	1450	1198	1003	847	722	620	463	351	269	206	157	118	87	61	40	22	425	"
11	3175	2482	1983	1616	1336	1118	945	806	692	518	393	301	231	177	133	99	70	46	27	400	"
12"	3500	2733	2187	1780	1472	1232	1042	888	763	571	434	333	256	195	148	110	78	52	30	380	"

3-6-40 "Steelcrete" Expanded Metal. Area = 0.400 sq. in. per ft. of width.

Slab.	Span.																			Unit stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
3"	431	333	263	211	171	140	116	96	80	56	38	25								650	9,750
3½	612	474	376	303	248	205	170	143	120	86	61	43	29	18						"	11,100
4	821	638	508	411	337	280	235	198	168	122	89	65	47	32	21					"	12,300
4½	1049	818	652	529	436	363	305	258	220	162	121	90	67	49	34	23				"	13,400
5	1307	1020	814	662	547	457	385	327	280	208	157	119	90	68	50	35	24			"	14,600
6	1797	1404	1124	915	757	634	536	457	393	295	225	173	133	102	78	58	42	28		630	16,000
7	2161	1688	1352	1102	912	764	647	553	475	357	273	210	163	126	96	73	53	37	24	570	"
8	2527	1976	1580	1290	1068	895	758	648	556	419	320	247	192	149	114	87	64	45	30	525	"
9	2898	2266	1813	1479	1226	1027	870	744	640	482	369	286	222	173	133	102	76	55	37	485	"
10	3265	2553	2043	1665	1380	1158	981	839	722	545	417	323	251	196	152	116	87	63	42	455	"
11	3633	2841	2275	1856	1538	1289	1093	934	805	607	466	361	282	220	170	131	98	72	49	425	"
12"	3995	3128	2505	2043	1694	1421	1204	1030	887	670	514	398	311	243	189	145	109	80	55	405	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 650\#/\text{sq. in.}$ $M = \frac{1}{12} w l^2$. Max $f_s = 16{,}000\#/\text{sq. in.}$

3-6-45 "Steelcrete" Expanded Metal. Area = 0.450 sq. in. per ft. of width.

Slab.	Span. 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Unit stresses lbs. per sq. in. Concrete	Steel.
3"	447	345	273	219	178	146	121	101	84	58	40	27								650	9,040
3½	635	493	390	315	257	213	178	149	126	90	65	46	31	20						"	10,250
4	852	663	528	427	351	292	245	207	176	128	94	69	50	35	24					"	11,400
4½	1092	851	679	552	454	379	319	271	231	171	127	96	72	53	38	26				"	12,500
5	1356	1058	846	688	568	475	401	341	293	218	165	126	96	72	54	39	27			"	13,500
6	1945	1520	1217	993	823	690	584	499	430	324	248	192	149	116	90	69	51	37	25	"	15,400
7	2431	1902	1524	1245	1032	867	735	629	543	410	316	246	193	151	119	92	70	52	37	610	16,000
8	2841	2225	1783	1456	1208	1014	861	737	636	482	371	289	227	179	140	109	84	63	45	560	"
9	3256	2548	2042	1668	1385	1163	988	846	730	553	426	333	262	207	163	127	99	75	54	520	"
10	3665	2873	2303	1880	1560	1311	1114	954	823	624	480	377	296	234	184	144	112	85	62	490	"
11	4083	3201	2565	2096	1741	1463	1242	1064	919	697	539	421	332	263	208	163	127	97	72	460	"
12"	4500	3525	2828	2310	1917	1611	1369	1173	1013	769	594	465	367	290	230	181	141	108	80	435	"

3-6-50 "Steelcrete" Expanded Metal. Area = 0.500 sq. in. per ft. of width.

Slab.	Span. 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Unit stresses lbs. per sq. in. Concrete	Steel.
4"	882	687	547	443	364	303	254	215	183	134	99	73	54	38	26					650	10,700
4½	1137	886	707	575	474	396	334	283	242	180	135	101	77	57	41	29	19			"	11,700
5	1403	1096	876	713	590	493	416	355	304	227	172	132	101	77	58	42	30	19		"	12,600
6	2022	1581	1266	1033	857	719	609	521	449	339	260	202	158	124	96	74	56	41	28	"	14,500
7	2693	2111	1693	1383	1149	966	821	704	608	463	358	281	222	176	140	111	87	67	50	"	16,000
8	3150	2468	1980	1620	1345	1131	961	824	713	542	420	330	261	208	165	131	103	80	61	595	"
9	3613	2830	2270	1858	1543	1298	1104	948	820	624	484	381	302	241	192	153	121	94	72	550	"
10	4070	3185	2560	2094	1739	1463	1245	1068	924	704	546	430	341	272	218	173	137	107	82	520	"
11	4533	3553	2853	2333	1939	1632	1388	1191	1031	785	610	481	382	305	244	195	155	122	94	490	"
12"	4990	3910	3140	2570	2135	1796	1528	1312	1135	866	672	530	421	337	270	215	171	135	104	465	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 650^{\#}/\text{sq.in.}$ $M = \frac{1}{12} w l^2.$ Max. $f_s = 16{,}000^{\#}/\text{sq.in.}$

3-6-55 "Steelcrete" Expanded Metal. Area = 0.550 sq. in. per ft. of width.

Slab	Span																			Unit stresses lbs. per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
4"	790	613	487	394	323	268	224	189	160	116	84	61	43	29	19					650	9,600
4½	1031	804	640	519	427	356	299	253	216	159	118	88	65	47	33	21				"	10,500
5	1300	1014	810	659	544	454	383	326	279	207	156	118	89	67	49	35	23			"	11,500
6	1909	1493	1195	974	807	676	573	489	421	317	242	187	145	113	87	66	49	35	23	"	13,200
7	2611	2044	1640	1340	1113	935	794	680	588	446	345	270	213	168	133	105	82	62	46	"	14,800
8	3330	2610	2095	1715	1425	1199	1020	876	758	578	448	353	281	225	180	144	114	90	69	640	16,000
9	3833	3006	2413	1976	1641	1382	1176	1010	875	668	520	410	326	261	210	168	134	106	83	595	"
10	4340	3400	2733	2235	1859	1565	1333	1145	991	757	589	465	371	298	239	193	154	122	95	555	"
11	4848	3803	3053	2502	2080	1753	1491	1282	1110	848	661	523	417	335	270	217	175	139	109	525	"
12"	5350	4200	3375	2761	2298	1935	1648	1416	1226	937	731	578	462	371	299	241	194	155	122	495	"

3-6-60 "Steelcrete" Expanded Metal. Area = 0.600 sq. in. per ft. of width.

Slab	Span																			Unit stresses lbs per sq. in.	
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
4"	809	629	500	404	332	275	230	194	165	120	87	64	45	31	20					650	9,000
4½	1063	828	660	536	442	368	309	262	224	165	123	92	68	50	35	24				"	10,000
5	1338	1044	834	678	560	468	395	336	288	215	162	123	94	71	52	38	26			"	10,800
6	1965	1535	1230	1004	831	697	591	505	435	328	251	195	152	118	92	70	52	38	26	"	12,500
7	2688	2105	1690	1382	1146	964	819	703	607	461	357	280	221	176	140	110	87	67	50	"	14,000
8	3490	2738	2200	1800	1496	1260	1073	921	798	609	474	375	299	240	193	155	124	99	77	"	15,400
9	4178	3278	2630	2156	1793	1511	1288	1107	960	735	574	455	364	294	238	193	156	125	100	620	16,000
10	4720	3705	2975	2438	2030	1710	1458	1254	1087	833	651	516	413	334	271	220	178	143	114	585	"
11	5283	4143	3333	2729	2271	1914	1633	1404	1218	933	730	579	465	376	305	248	202	163	131	550	"
12"	5835	4580	3680	3015	2510	2118	1804	1552	1346	1032	808	642	515	416	338	275	224	181	146	520	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 650$ #/sq. in. $M = \frac{1}{12} w l^2$ Max. $f_s = 16{,}000$ #/sq. in.

3-6-75 "Steelcrete" Expanded Metal. Area = 0.750 sq. in. per ft. of width.

Slab.	Span. 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Unit stresses lbs. per sq. in. Concrete	Steel
5"	1281	999	798	648	535	446	377	320	274	203	153	116	87	65	48	34	22			650	9,000
6	1929	1508	1208	985	815	684	579	495	426	321	246	190	148	115	89	68	50	36	24	"	10,500
7	2688	2105	1688	1382	1147	964	819	703	607	461	357	280	221	176	140	110	87	67	50	"	11,900
8	3530	2768	2222	1820	1513	1275	1085	932	808	617	481	380	303	243	196	158	127	101	79	"	13,100
9	4468	3508	2818	2308	1923	1623	1383	1190	1033	793	620	494	397	321	262	214	174	141	114	"	14,300
10	5485	4310	3465	2845	2370	2000	1708	1471	1279	984	773	617	499	406	333	274	226	186	152	"	15,400
11	6383	5018	4038	3313	2763	2333	1993	1718	1493	1152	906	725	587	481	395	327	271	224	185	630	16,000
12	7085	5565	4480	3675	3065	2590	2212	1908	1660	1280	1007	806	654	535	440	364	302	250	207	600	"
13	7778	6108	4918	4038	3363	2843	2429	2096	1823	1405	1108	888	720	589	486	402	334	277	230	565	"
14	8465	6655	5360	4395	3665	3097	2645	2285	1985	1532	1209	968	786	643	531	439	365	304	252	545	"
15	9173	7208	5803	4763	3973	3355	2868	2475	2151	1661	1309	1049	852	699	577	478	398	331	275	520	"
16"	9860	7760	6245	5130	4275	3615	3088	2665	2320	1790	1411	1132	919	754	622	516	430	358	297	500	"

3-6-100 "Steelcrete" Expanded Metal. Area = 1.000 sq. in. per ft. of width.

Slab.	Span. 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Unit stresses lbs. per sq. in. Concrete	Steel
5"	1391	1087	868	707	584	489	412	351	301	225	171	130	99	76	57	41	29	19		650	7,500
6	2113	1653	1325	1081	897	753	639	547	472	357	275	214	168	132	104	81	62	46	33	"	8,700
7	2948	2313	1856	1518	1263	1063	905	776	672	513	399	315	250	200	161	129	103	81	63	"	9,900
8	3870	3038	2441	2000	1665	1404	1196	1030	893	684	536	425	341	276	224	182	148	120	96	"	10,900
9	4908	3853	3103	2543	2118	1789	1527	1316	1143	880	692	552	446	363	298	245	202	166	136	"	11,900
10	6015	4735	3810	3125	2607	2203	1883	1624	1413	1090	859	687	558	457	377	312	259	215	179	"	12,900
11	7233	5683	4583	3763	3138	2653	2268	1961	1705	1319	1042	838	682	561	465	387	323	271	227	"	13,800
12	8560	6740	5430	4465	3725	3152	2699	2330	2030	1573	1245	1003	819	675	562	470	395	333	281	"	14,700
13	9928	7818	6298	5178	4323	3658	3133	2708	2363	1832	1453	1173	959	794	662	556	469	397	337	"	15,500
14	11185	8805	7095	5835	4875	4130	3535	3058	2665	2070	1644	1328	1089	901	753	633	535	454	386	640	16,000
15	12113	9533	7683	6313	5278	4468	3828	3313	2888	2243	1781	1438	1179	977	817	687	581	494	420	615	"
16"	13050	10260	8280	6810	5690	4815	4125	3565	3110	2418	1920	1552	1272	1055	881	742	628	533	454	590	"

"Steelcrete" MESH SLAB TABLES

for use with

CINDER CONCRETE.

Maximum Stress in Steel = 16,000 lbs. per sq. inch.
Maximum Stress in Concrete = 300 lbs. per sq. inch.

Maximum Bending Moment = $M = \frac{1}{12} w l^2$.

where

w = total load per sq. ft.

l = center to center span.

3-13-075 "Steelcrete" Expanded Metal. Area = 0.075 sq. in per ft. of width.														Unit Stresses lbs. per sq. in.	
Slab	Span														
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"				Concrete	Steel.
3"	121	89	67	50	38	28	20							265	16,000
3½	151	112	84	64	48	36	26	19						235	"
4	182	136	103	79	60	45	34	25						215	"
4½	213	159	121	92	71	54	41	30	21					200	"
5	244	182	138	106	82	62	47	35	25					185	"
6	305	229	174	134	103	80	61	45	33	14				165	"
7	368	277	212	163	126	98	75	57	42	19				150	"
8	430	323	247	191	148	115	89	67	50	23				135	"
9	494	372	285	220	172	133	103	79	59	28				125	"
10	555	418	320	248	193	150	116	89	67	33				120	"
11	619	467	358	278	217	169	131	101	76	38				110	"
12"	682	515	395	306	239	187	145	112	84	42				105	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs per sq. ft.

Max. $f_c = 300\#/$sq. in. $M = \frac{1}{12}wl^2$. Max. $f_s = 16,000\#/$sq. in.

3-13-10 "Steelcrete" Expanded Metal. Area = 0.100 sq. in. per ft of width

Slab	Span 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"		Unit Stresses lbs. per sq. in. Concrete	Steel
3"	157	118	90	69	54	41	32	24						300	15,100
3½	209	158	122	95	74	58	45	35	27					280	16,000
4	252	191	148	115	91	72	57	45	35	19				255	"
4½	294	223	173	135	107	85	67	53	41	24				235	"
5	336	255	198	155	123	97	77	61	48	28				220	"
6	420	320	248	195	155	123	98	78	62	37				195	"
7	507	387	301	237	188	150	120	96	77	46	25			175	"
8	593	452	352	277	221	177	142	113	90	55	30			160	"
9	678	518	403	318	254	204	164	131	105	65	36			150	"
10	765	584	455	359	287	230	185	149	119	74	42	18		140	"
11	853	651	508	401	320	258	208	167	134	84	48	22		130	"
12"	938	717	559	442	353	284	229	185	148	93	54	24		125	"

3-13-125 "Steelcrete" Expanded Metal. Area = 0.125 sq. in. per ft. of width

Slab	Span 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	Unit Stresses lbs. per sq. in. Concrete	Steel
3"	170	129	99	76	60	46	36	28	21					300	13,100
3½	245	187	145	114	90	72	57	46	36	21				"	14,900
4	320	245	191	152	121	98	79	64	52	33	19			290	16,000
4½	374	286	224	177	142	115	93	76	61	39	24			265	"
5	427	328	256	204	163	132	107	87	71	46	28			250	"
6	535	410	321	256	205	166	136	111	90	59	37	20		220	"
7	644	495	388	309	249	202	165	135	111	73	47	27		200	"
8	753	579	454	362	292	237	194	159	131	87	56	33		185	"
9	864	664	522	416	336	274	224	184	152	102	66	40	20	170	"
10	972	748	588	469	379	308	253	208	171	115	75	45	23	160	"
11	1082	834	655	523	423	345	283	233	192	130	85	52	27	150	"
12"	1193	918	723	577	466	380	312	257	212	143	94	58	30	140	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. f_c = 300#/sq. in. $M = \frac{1}{12} w l^2$. Max. f_s = 16,000#/sq. in.

3-9-15 "Steelcrete" Expanded Metal. Area = 0.150 sq. in. per ft. of width

Slab	Span 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"			Unit Stresses lbs. per sq. in. Concrete	Steel.
3"	182	138	106	83	65	51	40	31	24								300	11,700
3½	262	200	155	123	98	78	63	50	40	24							"	13,300
4	356	273	214	170	137	111	91	74	60	40	25						"	14,800
4½	453	349	274	219	177	145	119	98	81	55	36	23					"	16,000
5	518	399	314	251	203	166	137	113	93	64	43	27					275	"
6	648	500	394	315	256	209	172	143	118	81	55	35	20				245	"
7	779	602	475	381	309	253	209	174	145	100	68	45	27				220	"
8	912	704	555	446	362	297	246	204	170	118	81	54	33				205	"
9	1045	808	638	512	417	343	283	236	197	138	95	64	40	21			190	"
10	1178	910	719	578	470	386	320	266	223	156	108	72	45	25			175	"
11	1313	1015	803	645	525	432	358	298	250	175	122	82	53	29			165	"
12"	1446	1119	885	711	579	476	395	329	275	194	135	91	59	33			160	"

3-9-20 "Steelcrete" Expanded Metal. Area = 0.200 sq. in. per ft. of width

Slab	Span 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	Unit Stresses lbs. per sq. in Concrete	Steel.
3"	201	153	118	93	73	58	46	36	29								300	9,700
3½	290	222	173	137	110	89	72	58	47	30							"	11,100
4	392	302	237	189	153	125	102	84	69	47	31						"	12,300
4½	503	389	307	246	200	164	136	113	94	65	45	29					"	13,500
5	628	486	385	310	253	208	173	144	121	86	60	41	27				"	14,600
6	869	674	536	432	354	293	245	206	174	125	90	65	45	30			290	16,000
7	1046	813	645	522	428	355	297	250	212	153	111	80	57	38	24		260	"
8	1223	951	755	611	501	416	348	293	248	180	131	95	67	46	29		240	"
9	1404	1091	868	702	576	478	400	338	286	208	152	111	80	55	36	20	220	"
10	1580	1229	977	792	649	539	452	381	323	235	172	126	90	63	41	23	210	"
11	1763	1370	1090	883	725	603	505	427	362	264	194	142	103	72	48	28	200	"
12"	1943	1511	1202	973	800	665	557	471	400	292	214	157	114	80	53	31	185	"

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. $f_c = 300$ #/sq. in. $\qquad M = \frac{1}{12} w l^2. \qquad$ Max. $f_s = 16{,}000$ #/sq. in.

3-6-45 "Steelcrete" Expanded Metal — Area = 0.450 sq. in. per ft of width

Slab.	Span 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Unit Stresse lbs. per sq. i Concrete	Stee
3"	251	192	150	119	95	77	62	51	41	26										300	5,60
$3\frac{1}{2}$	366	282	222	177	144	117	97	80	66	45	30	19								"	6,40
4	500	386	306	246	201	165	138	115	96	69	48	33	22							"	7,20
$4\frac{1}{2}$	649	503	400	323	264	219	183	154	130	94	68	49	34	22						"	8,00
5	812	632	503	407	335	278	233	197	167	122	90	66	48	33	22					"	8,70
6	1182	922	736	598	493	412	347	295	252	187	140	106	80	59	43	30	20			"	10,00
7	1604	1253	1003	817	676	566	479	408	351	263	201	154	119	91	69	52	37	26		"	11,20
8	2065	1616	1294	1056	875	735	623	532	459	347	266	206	161	126	98	75	57	42	29	"	12,20
9	2579	2019	1619	1324	1099	923	784	672	580	440	340	266	210	166	132	103	80	62	46	"	13,30
10	3139	2459	1974	1614	1342	1129	959	824	713	543	422	332	264	210	168	134	106	83	64	"	14,30
11	3735	2930	2355	1925	1601	1350	1149	988	855	654	509	403	322	259	209	168	135	108	85	"	15,20
12"	4345	3405	2738	2245	1867	1575	1340	1154	1000	766	599	475	380	307	249	202	164	132	105	"	16,00

3-6-50 "Steelcrete" Expanded Metal. — Area = 0.500 sq. in. per ft. of width

Slab.	Span 4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Unit Stresse lbs. per sq. i Concrete	Stee
4"	513	397	315	253	207	171	142	119	100	71	50	35	23							300	6,70
$4\frac{1}{2}$	667	518	411	332	272	226	189	159	134	97	71	51	36	24						"	7,40
5	834	650	517	419	344	286	240	203	173	126	93	69	50	36	24					"	8,10
6	1216	949	758	616	508	425	358	305	261	194	146	111	84	63	46	33	22			"	9,30
7	1653	1291	1033	843	697	584	494	422	363	273	208	160	124	96	73	55	40	28		"	10,40
8	2143	1678	1344	1097	910	763	648	555	478	362	278	217	170	133	104	81	62	46	33	"	11,50
9	2674	2094	1679	1374	1140	959	815	698	604	459	355	279	220	175	139	110	86	67	50	"	12,50
10	3244	2544	2044	1671	1389	1169	995	854	740	564	438	346	275	220	177	142	113	89	69	"	13,40
11	3865	3035	2435	1995	1660	1398	1192	1025	888	679	531	420	336	271	219	177	143	115	91	"	14,30
12"	4535	3560	2860	2345	1952	1645	1403	1207	1047	803	629	500	401	325	265	216	176	142	115	"	15,10

"Steelcrete" MESH SLAB TABLES

Giving safe live loads in lbs. per sq. ft.

Max. f_c=300 #/sq. in. $M=\frac{1}{12}wl^2$. Max. f_s=16,000 #/sq. in

3-6-55 "Steelcrete" Expanded Metal. Area=0.550 sq. in. per ft. of width																				Unit Stresses lbs. per sq. in.	
Slab	Span.																				
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
4"	450	347	274	220	179	147	121	101	84	57	40	26								300	5,900
4½	599	464	368	297	242	200	167	140	117	84	60	42	28							"	6,600
5	765	594	472	382	313	260	217	183	155	113	82	59	42	29						"	7,300
6	1143	892	711	578	476	397	334	284	242	179	134	101	75	56	40	27				"	8,400
7	1584	1238	989	807	667	559	473	403	346	259	197	151	117	89	68	50	36	24		"	9,500
8	2073	1623	1299	1061	879	738	625	535	461	348	267	207	162	127	99	76	57	42	29	"	10,600
9	2609	2044	1639	1339	1112	935	794	681	588	446	345	270	213	169	134	106	82	63	47	"	11,500
10	3194	2504	2011	1644	1367	1150	979	840	728	554	430	339	270	216	173	138	110	86	67	"	12,400
11	3815	2993	2405	1968	1638	1380	1175	1010	875	669	522	413	331	266	215	174	140	112	89	"	13,200
12"	4505	3535	2840	2327	1937	1635	1393	1198	1040	797	624	496	398	322	262	213	174	141	113	"	14,000

3-6-60 "Steelcrete" Expanded Metal. Area=0.600 sq. in. per ft. of width.																				Unit Stresses lbs. per sq. in.	
Slab	Span.																				
	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"	13'-0"	14'-0"	15'-0"	16'-0"	17'-0"	18'-0"	Concrete	Steel.
4"	459	354	280	225	183	150	124	103	86	60	41	28								300	5,600
4½	612	475	376	304	248	205	171	143	121	86	62	44	30	19						"	6,200
5	780	607	482	390	320	266	223	188	159	116	85	62	44	30	20					"	6,800
6	1171	913	728	592	488	408	344	292	249	185	139	105	79	58	42	29	19			"	8,000
7	1622	1266	1013	826	683	573	485	413	355	266	203	156	121	93	71	53	39	27		"	9,000
8	2128	1665	1334	1089	903	759	643	551	475	359	276	215	168	132	103	80	61	45	32	"	10,000
9	2684	2103	1686	1379	1144	963	819	702	606	461	357	280	222	176	140	111	87	67	51	"	10,900
10	3284	2576	2069	1693	1407	1184	1008	866	749	572	445	351	280	224	180	144	115	91	71	"	11,700
11	3935	3085	2480	2032	1690	1425	1213	1044	905	693	541	429	344	277	225	182	147	119	94	"	12,500
12"	4620	3625	2915	2387	1987	1677	1430	1231	1068	820	642	511	411	333	271	222	181	147	119	"	13,300

THE "STEELCRETE" BEAM WRAPPER.

The Expanded Metal Steelcrete System of beam wrapping has been developed to meet the requirements of the new rule of the Bureau of Buildings for the Borough of Manhattan.

Until the advent of our system there had been no standard used, every one having some home-made device of his own, and the result has been that considerable trouble has resulted from the concrete breaking away from the beams and falling. With our system this is impossible.

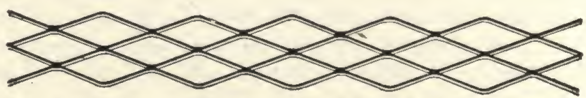
Our beam wrapping material consists of 3" No. 16 guage (stubbs) Steelcrete Expanded Metal, in strips two diamonds wide and six feet long. It is of the proper size for wrapping the soffits of beams from the smallest to twenty-four inches.

One size of material only is required to cover a large range of beams, which is extremely desirable and economical.

In special width, for instance where two beams come together, we can furnish this material three or four diamonds wide.

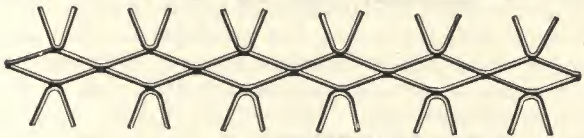
The material is easy to apply and cannot be spaced unevenly or displaced when once in position.

The following illustrations explain our "Expanded Metal Steelcrete System of Beam Wrapping."

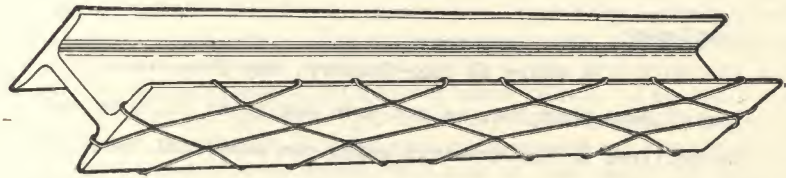


The above shows the way the material is received.

It is then cut as shown with a pair of tinner's snips or shears,



The strands are then pulled out.



And the material applied to the soffit of the beam.

When the concrete is applied it is bonded by the beam wrapping and cannot loosen.

A bundle contains three packages or 900 lineal feet.

Approximate weight per bundle—100 lbs.

Architects and Engineers should specify as follows:

"The Expanded Metal Steelcrete System of Beam Wrapping shall be used on the soffits of all beams."

This System meets all requirements of the Bureau of Buildings for the Borough of Manhattan as can be seen from the reproduction of their letter on the following page.

THE BUREAU OF BUILDINGS

FOR THE BOROUGH OF MANHATTAN

220 FOURTH AVENUE

S.W. CORNER 18TH ST.

RUDOLPH P. MILLER, SUPERINTENDENT   RPM...BY   NEW YORK CITY Sept.30,1910.

Consolidated Expanded Metal Co.

1182.Broadway, City.

Gentlemen:

In reply to your inquiry, the Steelcrete System of Beam Wrapping, as you have explained it to me and as outlined in the drawings which you submitted, made of three-inch #16 expanded metal, meets the requirements of this bureau for the wrapping of the soffits of beams in fireproof construction.

Yours truly.

Rudolph P. Miller

Superintendent.

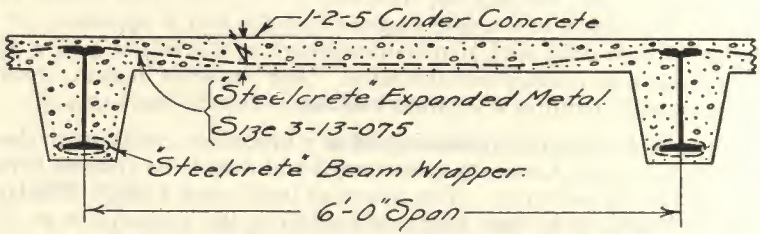
NEW YORK CITY FLOOR SLAB TESTS.

As a precedent condition to the use of any type of reinforcement in cinder concrete in Greater New York, it is required that the system in question shall be submitted to a load test. This load test is made on a sample floor slab constructed as nearly as possible under the same conditions as would be encountered in the practical application of that system. The material used for applying the load is pig iron, steel billets, or any other suitable material. One-tenth of the load sustained by the slab is approved for a safe live load in the design of floor slabs with that reinforcement of a span not greater than that actually tested and otherwise constructed the same. Any variation in span, thickness of slab and size of reinforcement requires a separate load test.

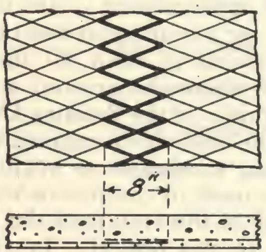
In accordance with these requirements and as a precedent condition to the same being used in New York City, this Company constructed and tested the systems hereafter given with the results noted on each one. The materials used were Lehigh Portland Cement, ordinary commercial sand, and steam hard coal cinders in the proportions of 1:2:5 respectively. The slabs were approximately 30 days old when tested. The loads actually sustained were in every case ten times the load for which it was approved. A distinguishing feature of these tests consists in that the reinforcement was not a continuous sheet over the whole span, but was made by lapping the ends of two sheets of mesh (8) inches or one diamond. This lap was made at the center of the span where the greatest stress would come upon it. This unusual test was made by the authorities of the Building Dept. of Greater New York in order to comply with that portion of the code which required that the reinforcement should be laid as nearly as possible to the same conditions as might be encountered in practice. Inasmuch as it was desired to use this mesh in continuous work, all requirements would be met in the tests as made. The result of this feature of the test was a strong confirmation of the assertions of this company in this respect. In every instance the slabs were tested to destruction, and in every instance the failure was in the steel outside of the lap. The lap remained intact and there was not the slightest indication of failure. The sheets of expanded metal were wired together at the lap every three feet in accordance with standard practice. This insures the correct position of the reinforcement during the pouring of the concrete.

"Steelcrete" REINFORCEMENT.

SYSTEM 101



This system was tested Oct, 18, 1911 for the Bureaus of Bldgs. of the Five Boroughs of Greater New York and approved Nov. 6, - 1911 for live loads up to and including 175 lbs. per sq. ft. when constructed as tested. The tests having been made with an 8" lap at the center of the span, it will be sufficient to allow the lap to be made wherever it may occur in the construction.



DETAIL OF REINFORCEMENT
SHOWING AN 8" LAP.
(one diamond)

FIRE PROOF FLOOR SYSTEM.

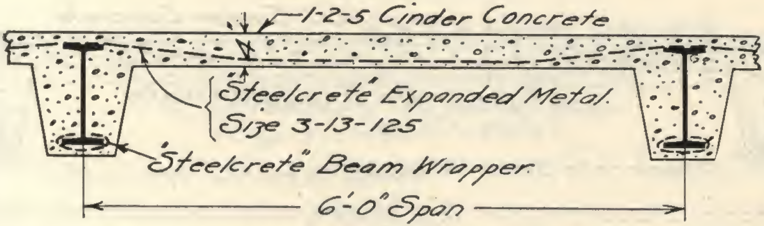
Reinforced with "Steelcrete" MESH.

THE EXPANDED METAL ENGINEERING CO.
NEW YORK AGENTS.

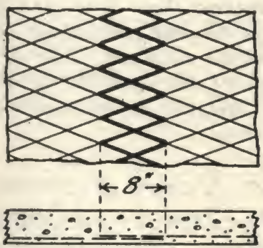
THE CONSOLIDATED EXPANDED METAL COS. MNFRS.
NEW YORK. PITTSBURGH.

"Steelcrete" REINFORCEMENT.

SYSTEM 102



This system was tested Oct. 20. 1911 for the Bureaus of Bldgs of the Five Boroughs of Greater New York and approved Nov. 6, 1911 for live loads up to and including 328. lbs. per sq. ft when constructed as tested. The tests having been made with an 8" lap at the center of the span, it will be sufficient to allow the lap to be made wherever it may occur in the construction.

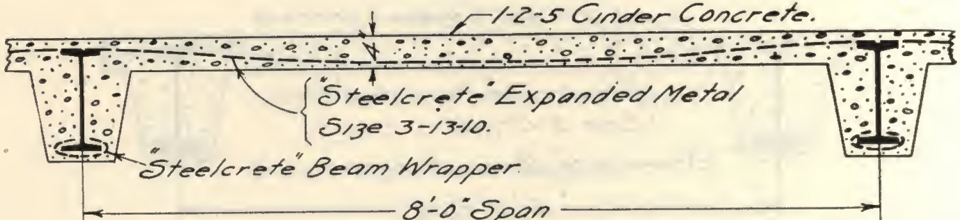


DETAIL OF REINFORCEMENT.
SHOWING AN 8" LAP.
(one diamond)

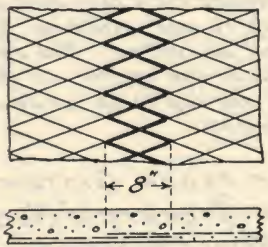
FIRE PROOF FLOOR SYSTEM
Reinforced with "Steelcrete" MESH.
THE EXPANDED METAL ENGINEERING CO.
NEW YORK AGENTS.
THE CONSOLIDATED EXPANDED METAL COS. MNFRS.
NEW YORK. PITTSBURGH.

"Steelcrete" REINFORCEMENT.

SYSTEM 103



This system was tested Oct. 16. 1911 for the Bureaus of Bldgs. of the Five Boroughs of Greater New York and approved Nov. 6. 1911 for live loads up to and including 94. lbs. per sq. ft. when constructed as tested. The tests having been made with an 8" lap at the center of the span, it will be sufficient to allow the lap to be made wherever it may occur in the construction

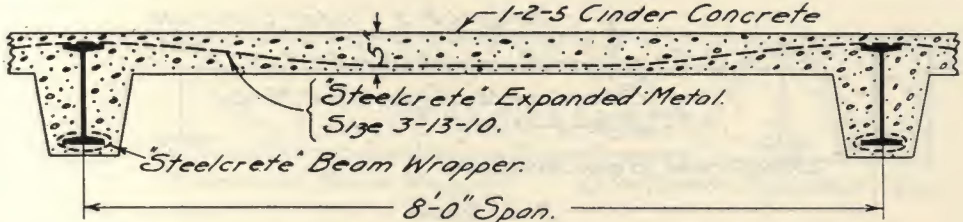


DETAIL OF REINFORCEMENT
SHOWING AN 8" LAP.
(one diamond)

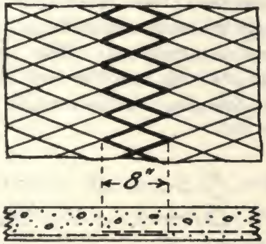
FIRE PROOF FLOOR SYSTEM
Reinforced with "Steelcrete" MESH.
THE EXPANDED METAL ENGINEERING CO.
NEW YORK AGENTS.
THE CONSOLIDATED EXPANDED METAL COS. MNFRS.
NEW YORK. PITTSBURGH.

"Steelcrete" REINFORCEMENT.

SYSTEM 105



This system was tested Oct. 17. 1911 for the Bureaus of Bldgs. of the Five Boroughs of Greater New York and approved Nov 6, 1911 for live loads up to and including 200 lbs per sq. ft. when constructed as tested. The tests having been made with an 8" lap at the center of the span, it will be sufficient to allow the lap to be made wherever it may occur in the construction.

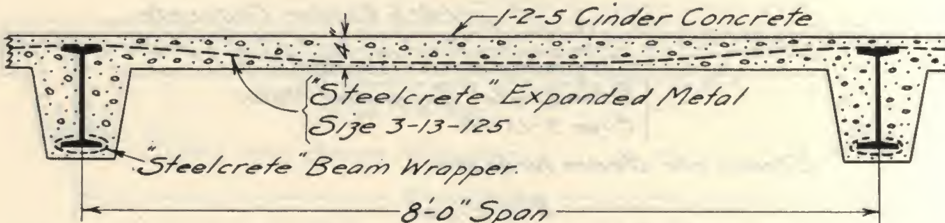


DETAIL OF REINFORCEMENT.
SHOWING AN 8" LAP.
(one diamond)

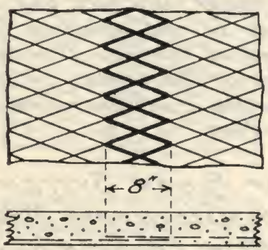
FIRE PROOF FLOOR SYSTEM
Reinforced with "Steelcrete" MESH
THE EXPANDED METAL ENGINEERING CO
NEW YORK AGENTS.
THE CONSOLIDATED EXPANDED METAL COS. MNFRS.
NEW YORK. PITTSBURGH.

"Steelcrete" REINFORCEMENT.

SYSTEM 106



This system was tested Oct. 21. 1911 for the Bureaus of Bldgs. Borrough of Manhattan, Greater New York and approved Jan. 18, 1912 for live loads up to and including 120 lbs. per sq. ft. when constructed as tested. The tests having been made with an 8" lap at the center of the span it will be sufficient to allow the lap to be made wherever it may occur in the construction.

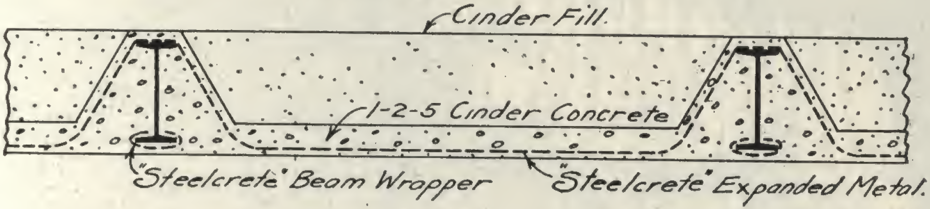


DETAIL OF REINFORCEMENT
SHOWING AN 8" LAP.
(one diamond)

FIRE PROOF FLOOR SYSTEM
Reinforced with "Steelcrete" MESH.
THE EXPANDED METAL ENGINEERING CO.
NEW YORK AGENTS.
THE CONSOLIDATED EXPANDED METAL COS. MNFRS.
NEW YORK. PITTSBURGH.

"Steelcrete" REINFORCEMENT

INVERTED SYSTEM



This style of construction has been approved by the Bureaus of Bldgs. of the Five Boroughs of Greater New York for the same live loads and corresponding constructions that have been tested and approved with the slabs on the upper flange of supporting beams.

FIRE PROOF FLOOR SYSTEM
Reinforced with "Steelcrete" MESH.
THE EXPANDED METAL ENGINEERING CO.
NEW YORK AGENTS.
THE CONSOLIDATED EXPANDED METAL COS. MNFRS.
NEW YORK. PITTSBURGH.

Test of Slab, reinforced with 3-13-075. Load of 1500 lbs. per sq. ft.
Deflection=$^{20}/_{64}$ths of an inch.

Coal Washery and Pit Building, Cambria Steel Co.

Floors, Bins and Outside Walls of Steelcrete Expanded Metal Construction.
Messrs. Heyl & Patterson, Engineers.

SEWERS AND CONDUITS.

Reinforced-concrete sewers and conduits were developed early in the history of reinforcement. The resistance to corrosion of this material in damp and wet soil and its susceptibility to special design over uncertain ground and through varying depths of fill, alike drew the attention of engineers to its possibilities. With the installment of the first reinforced concrete sewer, "Steelcrete" expanded metal mesh entered this field of usefulness and the long list of notable sewers, conduits, culverts and like structures in which this material has been used bears indisputable evidence to the adaptibility of this reinforcement to this type of structure. "Steelcrete" mesh possesses the happy combination of the two essential requirements: (1) that of being theoretically correct, (2) that of being essentially practical. We submit twelve reasons why "Steelcrete" mesh is superior for this particular type of structure to all other fabricated meshes or systems of reinforcement. Six of these reasons are theoretical considerations and six practical ones.

WHY "STEELCRETE" IS SUPERIOR.

Theoretical Considerations

(1) **It possesses a high elastic limit—not less than 55,000 lbs. per sq. in.** This is not attained at the sacrifice of quality or uniformity. "Steelcrete" is not a brittle and inferior steel but a tough, cold-drawn product with no equal in the market for uniformity of strength. The stresses encountered in sewer and pipe construction are uncertain and may exceed the calculated ones in apparently normal conditions. The need of a uniform, tough and reliable steel is at once apparent.

(2) **It provides against concentrated loads.** Its diamond-shaped structure enables it to distribute the effect of a sudden local load over a great many strands. No better, nor more ingenious method could be devised for this important function. With straight-line reinforcement only three or four strands are available, and sudden or concentrated loads are exceedingly injurious in such cases.

(3) **Attains a perfect bond in the concrete.** This is due to its mesh shape which does not permit any slipping and there is no possibility of it. The concrete and steel remain intact. No peeling or scaling of the concrete when subjected to heavy load.

(4) **Perfect distribution of Steel.** Every foot of width possesses the theoretical amount of steel. The accuracy here attained is inconceivable in loose rod reinforcement. Misplaced rods, even to a slight extent, increase the working stresses in part of the steel. Unit stresses that the specifications rigidly state must not exceed 15000 or 16000 lbs. per sq. in. in the calculations, in practice easily exceed 20000 and even 30000 lbs. per sq. in. by occasional grouping of loose rods or bent and twisted wires in a mesh.

(5) **Longitudinal reinforcement.** The sub-soil of sewers and conduits invariably possesses soft spots or even holes. "Steelcrete" mesh possesses strength in the longitudinal direction of the pipe equal to one third the strength in the circumferential direction. The theoretically correct amount in the longitudinal direction can never be known. This reinforcement automatically provides a liberal amount ample to take care of any normal condition.

(6) **Temperature stresses are guarded against.** These are sure to be encountered and must be provided for. Temperature cracks mean leaky construction. The form of the mesh provides a positive reinforcement against these uncertain but definite stresses.

Practical Considerations.

(7) **"Steelcrete" mesh is essentially a fool-proof reinforcement.** With the use of this material the man with the brains that designs the construction obtains from the unskilled laborer, to whom theoretical considerations are as meaningless as Sanskrit, an efficiency of 100 per cent with ordinary every day inspection.

(8) **"Steelcrete" Mesh is a stiff reinforcement.** It holds its position in the forms in a way that no other mesh equals. As the shape of the fabric provides a perfect distribution of the steel in a horizontal direction or in the plane of the sheet, so its stiffness insures a like perfect distribution in a vertical direction or in a direction at right angles to the plane of the flat sheet. In other words, it lies taut in place. No waves or warps to be hammered out or offer elements of weakness. Some fabricated wire reinforcements advertise the fact that the joint between the cross-wire and the main longitudinal wire is a hinge, i.e., will permit the buckling of the sheet in a vertical direction. This may be an advantage in some structures but it can be nothing but a detriment to a fabric to be used in sewer work or in flat floors. Engineers will be found to be unanimous in agreeing that **it is far more important to have the reinforcement placed correctly in a vertical direction than in the horizontal.** In this respect "Steelcrete" mesh is unequaled.

(9) **It is cheaper to install.** Requires less labor than any other mesh or system of rods. It is not sufficient to have the requisite amount of steel embedded in every 100 ft. of pipe. It must be properly distributed in every foot of the length. On the other hand the cost of installation must be reasonable. "Steelcrete" arrives on the job in flat sheets of standard lengths. It is easy to handle. Requires very little room to store many tons of it. The contractor does not have to install a small plant to bend and cut the steel to the required shape. This material is so well known everywhere that it is sufficient to call attention to the fact that the bending into a circular shape or any round bend is an exceedingly simple operation.

(10) **It is easy of inspection.** What this means to the engineer and contractor, the average man will never fully appreciate. No more unsatisfactory and trouble-brewing system can be found than the complicated network of bars sometimes attempted in the effort to save the first cost of steel only. The inspection incumbent on such method if honest results are to be attained, is an endless source of delay, anxiety, and worry to all parties concerned. The situation is serious enough in a flat floor slab and the difficulty of placing the reinforcement even there is recognized, but the complications encountered in a circular or egg-shaped sewer where the reinforcement has to cross the neutral axis and lay close first to the inside circumference then to the outside, crossing at critical points, makes the use of a positive system of reinforcement an essential feature of first class work.

(11) **It can be placed quickly.** This means a saving in overhead charges. This feature has been overlooked by a great many engineers and architects in the past. The injection of modern business methods and book-keeping by the large contracting firms into ordinary construction work has brought forward this important point to the prominence it is entitled to. The saving in labor by the use of "Steelcrete" mesh is only **half of the total.** A real and true saving exists in the cutting down of the overhead charges which may easily and often does exceed the total labor charges. This saving is effected by the consequent speed of the construction. In other words if a contractor can lay a certain number of feet of sewer a day with a given number of men by the use of "Steelcrete" mesh and in doing so he cuts down the time by twenty or thirty per cent, to the labor saved must be added saving in overhead charges which consists of superintendence, interest on investment of plant, office expenses, etc., all of which are real and vital expenditures

"Steelcrete" can be laid more quickly and more satisfactorily than any other type or system of reinforcement yet devised.

(12) Last but not least is the long list of successful and notable sewers and like structures in which this material has been used. These structures, because of their importance, have necessarily commanded the highest talent in the engineering profession. The use of "Steelcrete" mesh in this work is the highest endorsement this material could have.

CONDITIONS IN PRACTICE.

Basis of design.

On account of the uncertain nature and material of the foundations of ordinary sewers and the varying conditions of the point of application, as well as the direction and the amount of the loads, the design of sewers is rarely susceptible to a rigid mathematical investigation. Our table of sizes and reinforcement, found elsewhere in this pamphlet, is not based on a mathematical analysis, but on good modern practice. For a more complete discussion of the design of reinforced concrete sewers we would refer you to an article by Mr. Ernest McCullough in Engineering Record of Feb. 27, 1909, and Bulletin No. 22, University of Illinois April 29, 1908.

The following article is reprinted by permission of Mr. Arthur N. Talbot from Bulletin No. 22, University of Illinois, dated April 29, 1908 on reinforced concrete culvert pipe, etc.

CONDITIONS OF BEDDING AND LOADING FOUND IN PRACTICE.

Conclusions from tests.

"If the layer of earth immediately under the pipe is hard or uneven, or if the bedding of the pipe at either side is soft material or not well tamped, the main bearing of the pipe may be along an element at the bottom and the result is in effect concentrated loading. The result is to greatly increase the bending moment developed and hence the tendency of the pipe to fail. This condition may be aggravated in the case of a pipe with a stiff hub or bell where settlement may bring an unusual proportion of the bearing at the bell and the distribution of the pressure be far from the assumed condition. In bedding the pipe in hard ground it is much better to form the trench so that the pipe will surely be free along the bottom element, even after settlement occurs, so that the bearing pressure may tend to concentrate at points say under the one third points of the horizontal diameter (or even the outer quarter points). This will reduce the bending moments developed in the ring.

"In case the pipe is bedded in loose material, the effect of the settlement will be to compress the earth immediately under the bottom of the pipe more completely than will be the effect at one side, with the result that the pressure will not be uniformly distributed horizontally. Similarly, in a sewer trench, if loose material is left at the sides and the material at the extremity of the horizontal diameter is loose and offers little restraint, the pressure on the earth will not be distributed horizontally and the amount of bending moment will be materially different from that where careful bedding and tamping give an even distribution of bearing pressure over the bottom of the sewer.

"In case a small sewer in a deep trench, the load upon the sewer may be materially less than the weight on the earth above, where the earth forms a hard, compact mass and is held by pressure and friction against the side of the trench.

"In case a culvert pipe is laid in an ordinary embankment by cutting down the sides slopingly, it is evident that the load which comes upon the pipe will be materially less than the weight of the earth immediately above it. If a culvert pipe replaces a trestle and the filling is allowed to run down the slope, the direction and amount of the pressure against the pipe will differ considerably from that which obtains in a trench or in the case of a level filling. It is possible in the latter case that the small amount of settlement of the earth directly over the culvert pipe, due to the greater depth of earth on the adjacent sections, may allow a greater proportion of the load to rest upon the culvert pipe than would ordinarily be assumed.

"Attention should be called to the fact that the distribution of the pressure by means of earth under and over a ring assumes that the earth is compressed in somewhat the same way as when other material of construction is given compression. Unless the earth has elasticity, the distribution of the pressure cannot occur. To secure the uniform distribution assumed the ring itself must give enough to allow for the movement of the earth which takes place under pressure. This is especially true with reference to the presence and utilization of lateral restraint, and a ring which does not give laterally, as for example a plain concrete ring, will not develop lateral pressure in the adjoining earth under ordinary conditions of moisture and filling to any great extent. As the conditions of earth and moisture produce mobility and approach hydrostatic conditions, the necessity for this elasticity and movement do not exist, but here the lateral pressure approaches the vertical pressure in amount and the bending moments become relatively smaller.

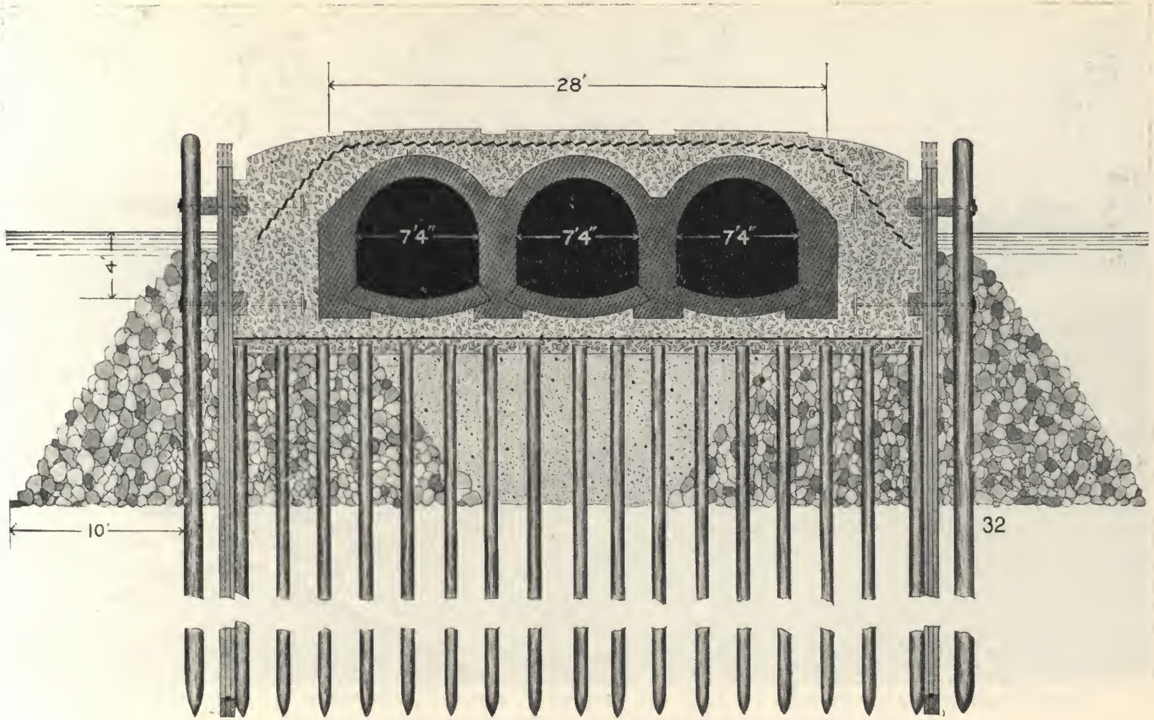
TABLES OF "STEELCRETE" REINFORCEMENT FOR SEWERS AND CONDUITS.

Inside Diameter	Thickness of concrete	Size of expanded metal
2'6"	3 1/2"	3-9-15
3'0"	3 1/2"	3-9-20
3'6"	3 1/2"	3-9-20
4'0"	3 1/2"	3-9-25
4'6"	4 "	3-9-25
5'0"	4 1/2"	3-9-30
5'6"	5 "	3-9-30
6'0"	5 1/2"	3-9-35
6'6"	6 "	3-9-35
7'0"	6 1/2"	3-6-40
7'6"	7 "	3-6-45
8'0"	7 1/2"	3-6-50

For egg shaped sewers use same size of expanded metal and thickness of concrete, the diameter given in the table being the horizontal diameter.

Under ordinary conditions these sewers may be used for any depth of fill and when required to sustain a heavy live load, such as a road roller, the depth of fill should be not less than 3'0" for the given size of reinforcement. When severe conditions of loading and bedding are encountered it is preferable to use two layers of expanded metal, one near the inside and one near the outside. A double reinforcement will generally provide for all contingencies. When using two layers of "Steelcrete" reinforcement select the next size of mesh lighter than that shown in the table.

It is important to note that in placing "Steelcrete" reinforcement in sewers and conduits the long way of the diamond should lie in the direction of the circumference and the short way of the diamond in the direction of the axis of the pipe. This will give the strongest method of reinforcement.



Outfall Sewer Across Tide-Water Marsh

Experimental Test of a Concrete Conduit reinforced with "Steelcrete" Expanded Metal for the Jersey City Water Supply Company.

Test at 21 days on section 8′6″ x 8′6″ x 10′0″ long. Walls at spring of arch 12 inches and at crown 5 inches. Load 25 tons steel rails. Only slight cracks shown. Total deflection seven-sixteenths inches.

Mr. E. W. Harrison, Consulting Engineer.

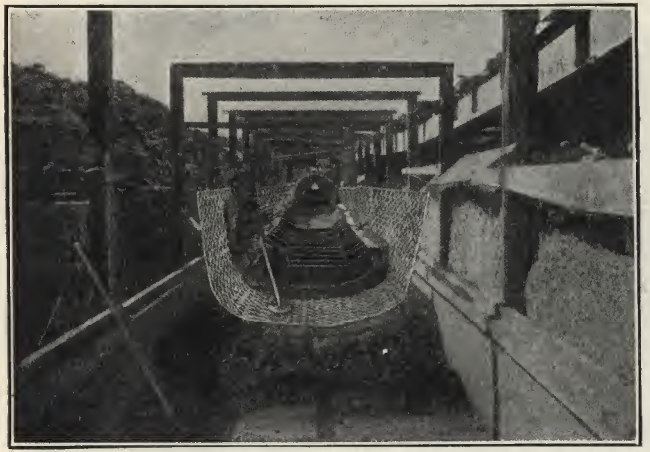
Water Conduit—Torresdale Filter Plant—Philadelphia.

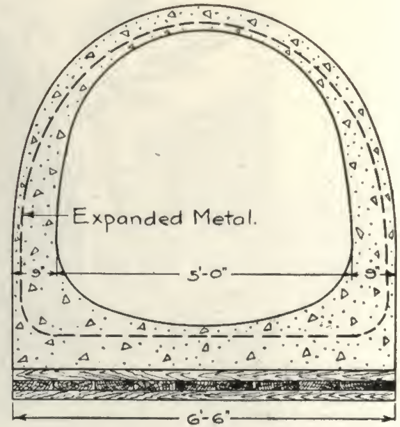
This section is 10 ft. in diameter and 850 ft. long, the water in this conduit being under a 20 ft. head. Thickness at crown 10 inches and at spring 16 inches.

Mr. John W. Hill, Chief Engineer of the Bureau of Filtration, City of Philadelphia.

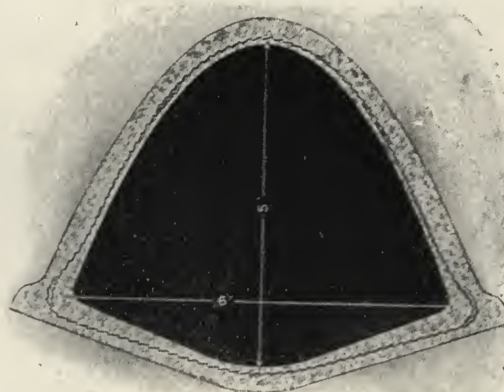
Mr. Daniel J. McNichol, Contractor.

"Steelcrete" Expanded Metal used throughout this large filtration.





A reinforced concrete sewer constructed by the Solvay Process Co. at Syracuse, N. Y. This sewer was to take care of 20,000,000 gallons of water per day, which is the product of a cooling process in their extensive plant. The length is 2,000 ft. and over 50,000 sq. ft. of "Steelcrete" Expanded Metal was used in the construction. This sewer was designed by Mr. George Root, Civil Engineer of the Solvay Co., and constructed under the general supervision of Mr. E. M. Trump, the chief engineer.

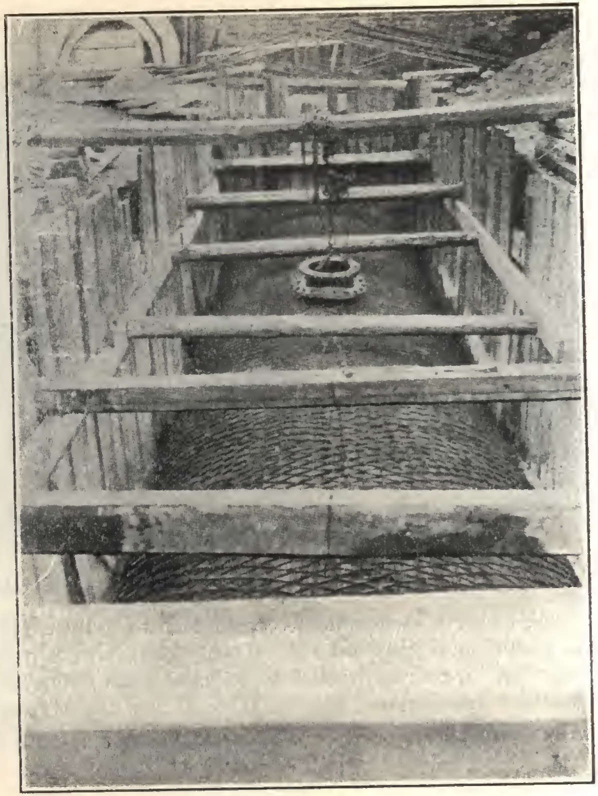


A Large Sewer in Harrisburg, Pa.

This sewer is three miles in length and was built to relieve an open creek from the discharge of sewers from a population of 20,000. The form is a parabolic arch, 5 ft. in height, with an almost flat invert and walls 5 to 6 inches thick. The problems of construction were many and difficult. "Steelcrete" Expanded Metal was used throughout.

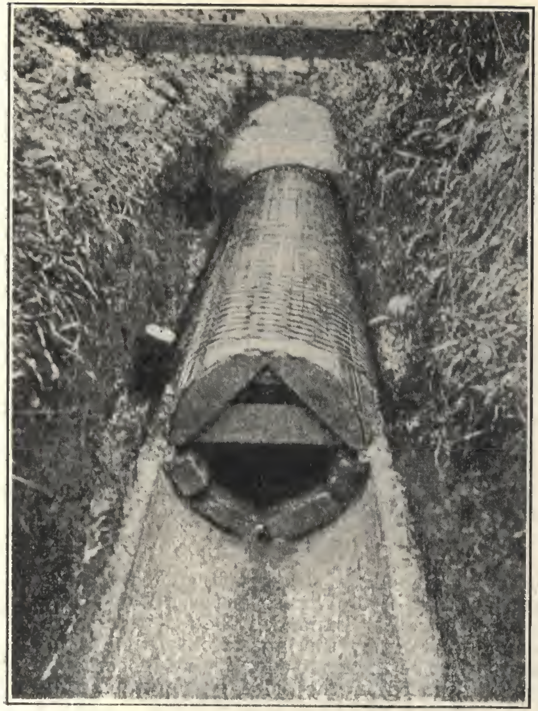
Designed by Mr. Jas. H. Fuertes, Sanitary Engineer of New York City.

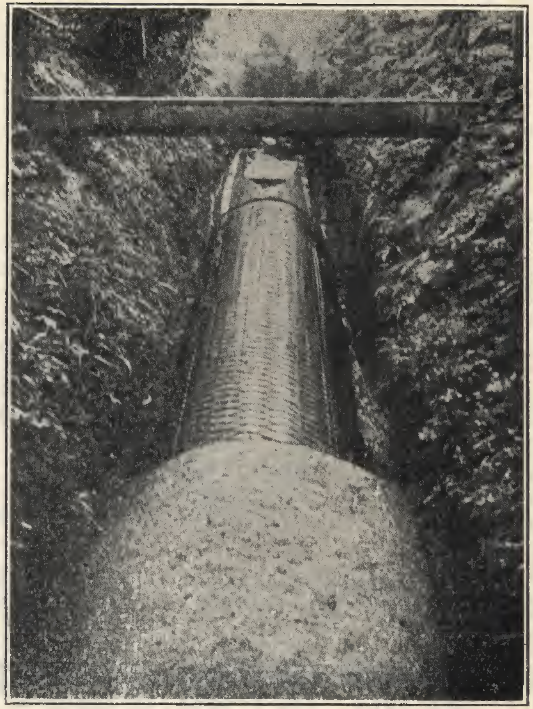
Mr. S. M. Neff, Contractor, New York City.



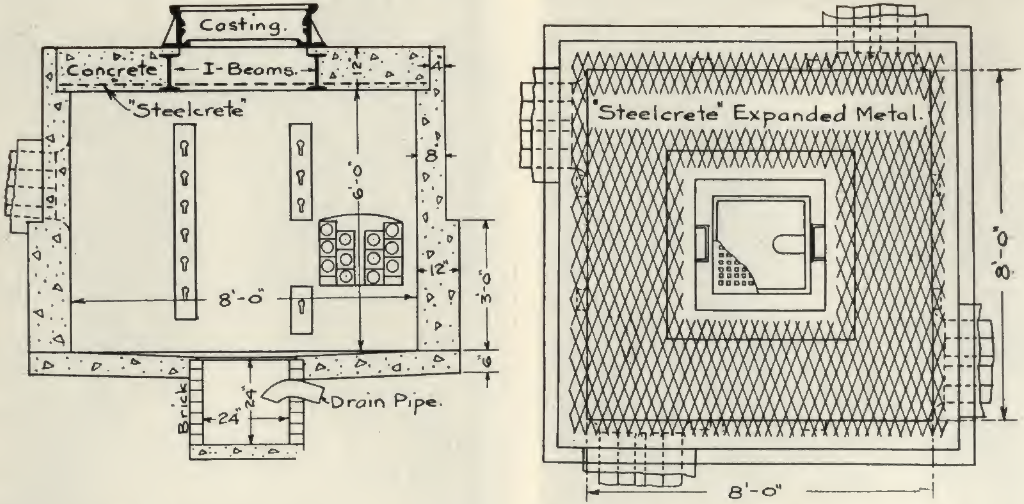
Expanded Metal in England.

Typical views of a large concrete pipe reinforced with Expanded Metal, in course of construction.





Expanded Metal—Concrete Sewer. Hartlepool Borough Council, England.
Mr. H. C. Crummack, A. M. I. C. E., Engineer.



Standard Manholes used in New York City by the Consolidated Telegraph and Electrical Subway Co., Mr. Edwin R. Quimby Chief Engineer. Nearly 4000 of these in use in New York City alone. The cover is a slab, reinforced with "Steelcrete" Expanded Metal, resting on I beams, and consumes the minimum amount of space, thus giving the largest obtainable room for operations in the chamber This construction is found to be the most durable and economical. Where marshy soil is encountered expanded metal is placed in the sides and bottom also.

Steelcrete Expanded Metal Lath.

The excellency of Steelcrete Expanded Metal Lathing as compared with other materials is an absolute guarantee of the only end desirable in the use of a lathing, viz., to clinch and hold mortar. This is its only purpose, and any lath which does not insure these results is a failure. It is impossible to plaster Steelcrete Expanded Metal lath without securing a perfect key with sufficient mortar on the reverse side to make this a certainty; and the argument used by manufacturers of sheet metal lathing is that their material saves mortar, which is condemnation of the material itself. It is the mortar which makes the wall, not the lathing.

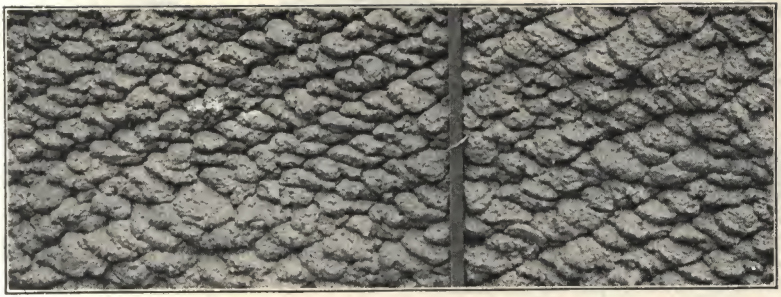
From the time it was first put on the market, to the present day, it has remained a standard lath. Many imitations and substitutes have been placed on the market, but no better or no more particularly economical metal lath has ever been produced. Owners, therefore, are particularly interested to see the specifications for their buildings call for Steelcrete Expanded Metal lath that they may secure the most efficient results in construction.

THIS IS
ONLY LATCHED.

THIS IS
KEYED MORTAR.

The above-mentioned advantage in the use of Steelcrete Expanded Metal Lath is only one of its superior points of excellence. The closeness of the mesh and the abundance of key make it possible to attach other features of construction without injury to the wall or other portions finished in the lath and plaster. In other words, it is possible to nail baseboards, door and window trim and picture moulding to Steelcrete Expanded Metal lath walls without harm to any portion of the work.

Our lath is now made in several different grades to meet all possible conditions. For exterior stucco work it is desirable to push the mortar well through the lath. This requires a stiff lath having large openings, but with the strands not too far apart. The Steelcrete "A" and Steelcrete "B" lath shown by Figure No.20, having oblong meshes, meet the usual requirements.



THE OTHER SIDE.

For certain interior work it is desirable to use as little mortar as possible. For this purpose the openings must be small and the lath itself must be thin. In such cases there is nothing better than our Steelcrete Diamond laths illustrated by Figure No.21. As previously stated, it is impossible to plaster Steelcrete Expanded Metal Lath without securing a perfect key with sufficient mortar on the reverse side to make this a certainty. The Steelcrete Diamond Laths are also particularly adopted for ornamental furring.

FIGURE 20. STEELCRETE "A" AND "B" LATH.

How to Specify.

In writing specifications it is desirable to be explicit and concise. To state the guage is not sufficient, as the strands might be of varying width. It is therefore necessary to give the weight of the finished product per square yard as well as the guage. Specify as follows: The metal lath shall be Steelcrete Diamond No. 24F guage weighing 3.57 pounds per square yard.

For method of applying lath see specifications on pages 98 and 99.

How to Order.

Order lath by the full "designation" as given in table herewith, giving the number of square yards or bundles required.

Remember it is always shipped in full bundles. For example: Ship 20 bundles 533⅓ square yards Steelcrete Diamond 24F lath painted or galvanized as may be desired.

Staples and Wire.

Lath should be wired to metal furring with No. 18 annealed steel wire. The following amounts are necessary. To tie 100 square yards, 7½ pounds for furring 16-inch centers and 9 pounds for furring 12-inch centers.

For fastening lath to wood studs or sheathing the staples should be long enough to penetrate the wood at least three fourths of an inch. The amount of staples of No. 14 guage for studs 16-inch centers per 100 yards is as follows: 10 pounds for 1-inch staples. For studs 12-inch centers 25 per cent more staples are required.

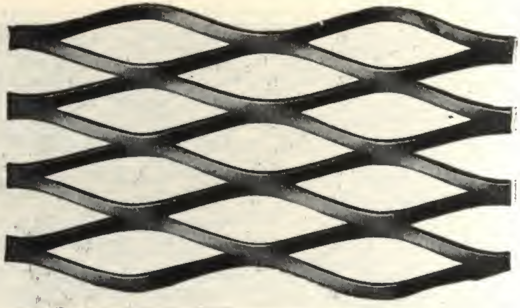


FIGURE 21 STEELCRETE DIAMOND LATH.

STEELCRETE EXPANDED METAL LATH

DESIGNATION	GAUGE U. S. STANDARD	SIZE OF SHEETS	SHEETS IN BUNDLE	SQ. YARDS IN BUNDLE	WT. PER SQUARE YD.	WT. PER BUNDLE
PAINTED						
Steelcrete A 22	22	18″x96″	15	20.00	4.37	87.40
Steelcrete A 24	24	18″x96″	15	20.00	3.56	71.20
Steelcrete B 27	27	18″x96″	15	20.00	2.41	48.20
Steelcrete Diamond 24	24	27″x96″	12	24.00	3.57	85.68
Steelcrete Diamond 24 F	24	24″x96″	15	26.66	3.57	95.18
Steelcrete Diamond 27 F	27	24″x96″	15	26.66	2.48	66.12
GALVANIZED						
Steelcrete A 22	22	18″x96″	15	20.00	4.37	87.40
Steelcrete A 24	24	18″x96″	15	20.00	3.56	71.20
Steelcrete B 27	27	18″x96″	15	20.00	2.41	48.20
Steelcrete Diamond 24	24	27″x96″	12	24.00	3.57	85.68
Steelcrete Diamond 24 F	24	24″x96″	15	26.66	3.57	95.18
Steelcrete Diamond 27 F	27	24″x96″	15	26.66	2.48	66.12

Partition construction of Steelcrete Expanded lath and mortar is of two general types, viz. solid and hollow partitions.

Partition Construction.

Figures Nos. 22 and 23 illustrate types of hollow partitions. Their many advantages over any other fireproof partitions are self-evident, but among the chief of them may be mentioned—

FIGURE 22

1. They are very light, strong and economical.
2. Plumbing, steam and gas pipes and electric wires may be concealed inside without danger from expansion in case of fire, and may be run either horizontally or vertically.
3. As the studs can be punched for grounds wherever desired, it is a very simple matter to provide nailings for wood finish.
4. They may be used for bearing partitions, if desired

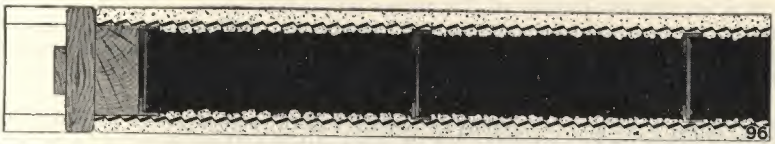


FIGURE 23

5. They can be made any thickness, from three inches up, with very slight increase in cost.
6. They are as near sound proof as any partitions can be made.
7. They can be plastered with common mortar, as the studs are stiff enough to require no further stiffening, although cement plaster or any of the patent hard mortars may be used.
8. As shown in detail, the ordinary method of framing around doors is used, thereby avoiding the use of specially designed frames.

Solid Partitions.

Figures Nos. 24, 25 and 26 show methods of building channel iron and Steelcrete Expanded Metal lath solid partitions. Suggestions for wood frames for doors are shown in Figures 25 and 26, and a very satisfactory detail for an iron frame for a tinned door is shown in Figure 24. It is necessary to use a hard

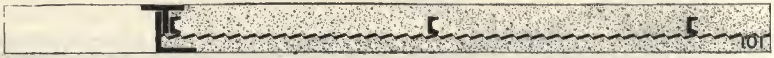


FIGURE 24.

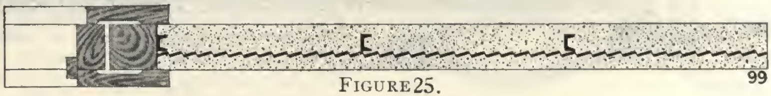


FIGURE 25.

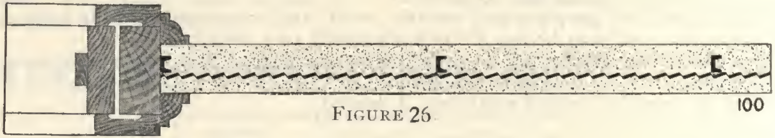


FIGURE 26

plaster or Portland cement mortar to make first-class construction. The partitions are practically sound proof, are light and do not require special framing to carry them, take up very little room and are not expensive. They have been used with success in every class of building.

Outside Wall Construction.

Figure No. 27 shows a method of building an outside wall of cement plaster on Steelcrete Expanded Metal lath and iron studs. This construction stands the weather well and is warm in winter and cool in

FIGURE 27.

summer. Figure 28 and 29 illustrate two methods of building this outside wall on wood studding. In

Figure 27 and 29, heads and jambs are shown, and in Figure 28 a jamb and sill are shown. When the wall is built as shown in Figure 27 and 28, the plaster on the outside face of the stud is backed up before the lathing is attached to the inside face of the stud. The two sources of cracks in this construction are

FIGURE 28.

unequal settlement of the foundation and shrinkage of the wood frame. If the footings are carefully designed and the details shown are used, both of these dangers are avoided. Where wooden sheathing is

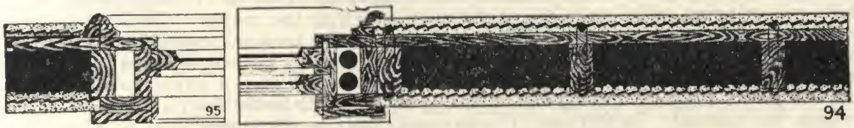


FIGURE 29

used it is advisable to apply a layer of water proof paper before applying the lath. The furring strips should not be more than ⅜″ thick so that the mortar will be pushed through the lath to the paper, thereby completely embedding the lath.

Specifications for Steelcrete Expanded Metal Lath and Plaster Ceilings.

Ceilings should be furred with small angles or channels not over 12 inches on centers and lathed with diamond mesh Steelcrete Expanded Metal lath, securely wired or clamped to the supporting angles or channels. These supporting members should be firmly clamped to the bottom flanges of the steel beams if the ceiling comes directly under steel beams supporting the floor or roof above. If concrete beams are used, furring clips or hangers should be set in place on the centering and concreted into the beams. If the ceiling is to be suspended below the floor or roof above, it should first be furred with 2-inch or 3-inch angle or channel purlins not over 4 feet or 5 feet on centers, supported by hangers securely clamped to the beams above or hung from rods or bars and concreted into the beams or slabs of the floor or roof above and spaced not more than 4 feet or 5 feet apart. Supports for ceilings to carry the weight of the ceiling only should be designed for from 10 to 12 pounds per square foot, while if workmen are to have access to the space above the ceiling, they should be designed for from 25 to 40 pounds per square foot. It is sometimes convenient to frame for ceilings with small structural beams or channels 4 feet or 5 feet on centers framed into the bottom chords of the roof trusses

Partitions. Partition studs should be set 12 inches on centers and firmly secured top and bottom; the lathing should be Steelcrete "A" Expanded Metal lath if applied on one side of the studs only, for a solid plaster partition; the diamond mesh Steelcrete Expanded Metal lath if the studs are to be lathed on both sides.

The lath should be securely wired or clamped to the studs every 4 inches and sheets should be lapped ½ inch on their long sides and 2 inches on their ends. Steelcrete Expanded Metal solid partitions may be plastered with cement mortar, patent hard plaster, wood pulp or asbestos plasters, while hollow partitions may be plastered with lime mortar as well as with the plasters specified above.

Outside Wall Furring. Outside walls should be furred with small angles or channels 12 inch on centers and lathed with diamond mesh Steelcrete Expanded Metal lath. If the wall is at all rough it is best to first fur the walls with horizontal angles or channels 3 feet or 4 feet apart vertically to line the wall and give a true, plump surface to receive the vertical furrings, which should be attached to them by wiring or bolting.

Outside Walls. Outside walls may be lathed with Steelcrete "A" Expanded Metal lath directly on the outside boarding, the wide strands being sufficient to give a thorough clinch to the mortar. Some architects prefer to omit the outside boarding and staple the "A" lath directly to the outside faces of the studs, and after the scratch coat of plaster is applied from the outside, to put on a heavy backing-up coat on the inside of the lath between the studding, to entirely encase the lath in cement and give a clinch for the mortar on the studs which will give a diagonal bracing and stiffening to the walls more than equivalent to the outside boarding which was omitted. In this case, it is necessary only to put trusses over openings in the usual manner and diagonal braces at the corners of the house to keep the frame in shape before plastering, and the solid cement wall will more than supply the rest of the stiffening necessary, at the same time making a building more weather-tight than any form of outside wall except masonry construction. The omission of the boarding removes the danger of cracks in the plaster due to shrinkage of the boards and further precautions against cracking are: to fur the lath from the studs with small iron rods, or flat bars on edge, over which the lath may be stapled or to which it may be wired. In case outside boarding is used, the lath should be furred off with wood strips or round or flat bars; but even then it is necessary to so thoroughly work the mortar through the meshes of the lath as to entirely enclose all of the metal. Outside walls should be plastered with best Portland cement mortar, using clean sand, and the scratch coat should contain sufficient hair to give a good clinch on the lathing, while the finish coat should be a rich mixture of cement and sand in order to present a hard, durable surface to the weather. If the wall is to be half-timbered, the best method for the half-timbering is to project an inch, more or less, from the face of the plaster and put on grounds with which the plaster will finish flush and then nail board, of the thickness desired to the grounds, lapping over the plaster a half inch on each side of the grounds, and it is better to have the boards rebated on the back to prevent warping. This method prevents shrinkage cracks showing up between the half-timbering strips. If the half-timbering is flush with and projects only slightly from the plaster, the edges of the boards should be beveled so that the exposed face is wider than the back.

Figures Nos. 30 and 33 show typical methods of fireproofing columns. These details are subject to modification according to the degree of thoroughness with which it is desired to have the fireproofing done, as, for instance, Figures 30 and 33 might be shown furred and filled solidly with concrete as in Figures Nos. 31 and 32, or Figures Nos. 31 and 32 might be shown wrapped closely with Steelcrete Expanded Metal lath and fireproofed with plaster as in Figure 30, and the space inside the lath filled with concrete or not, as desired.

Column Fireproofing.

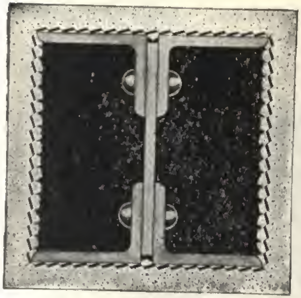


FIGURE 30.

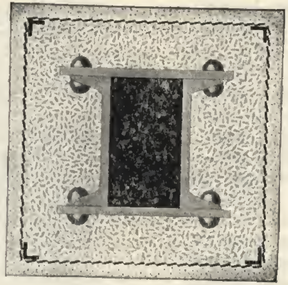


FIGURE 31.

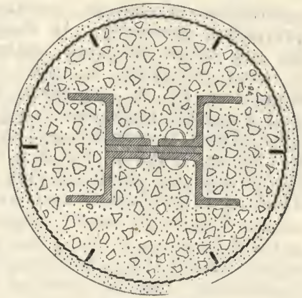


FIGURE 32.

Methods of Ceiling Construction.

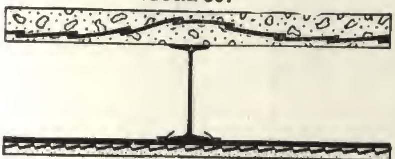


FIGURE 34. METHOD G.

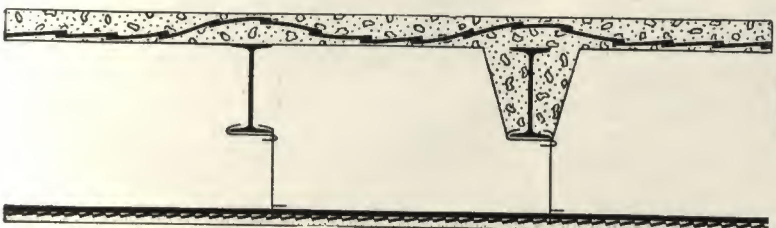


FIGURE 35. METHOD H.

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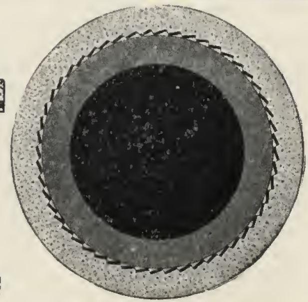


FIGURE 33

Stucco and How.

In the preceding pages have been shown, in fairly good detail, various methods for using Steelcrete Expanded Metal lathing in the construction of ceilings, partitions, and interior fireproofing generally. It should be said that like all other first-class materials, this must be used correctly; in other words, with intelligence. By its use there has been developed a specific trade, involving a scientific study of the subject. It cannot be put on "any old way." As a lathing material, which is its simplest use, it may be said that there is a right and a wrong way of putting on the sheet to receive mortar. By reference to Figures 20 and 21, pages 93 and 94, this fact will be noticed. On a side wall, for instance, lathing should always be put up as shown by these illustrations; that is, fibres of the metal should point up and outward. On the ceilings the sheets should always be put on one way, so that the plasterer may begin at the proper side of the area to accomplish his work.

Figure 36 is an illustration of the method of applying cement plaster and Steelcrete Expanded Metal lath to a building sheathed with rough boarding. The two sources of cracks in this construction are unequal settlement of the foundations and shrinkage of the wood frame. These difficulties are overcome first by having the footings carefully designed, and second by stapling ¼-inch round iron rods in a vertical position as shown, spaced twelve inches centers, to the boarding. Outside of these rods staple Steelcrete Expanded Metal lath.

For stucco work use the best Portland cement and sand that is clean, coarse and sharp. For the scratch coat add to the above lime putty with long cattle hair or fibre worked well together.

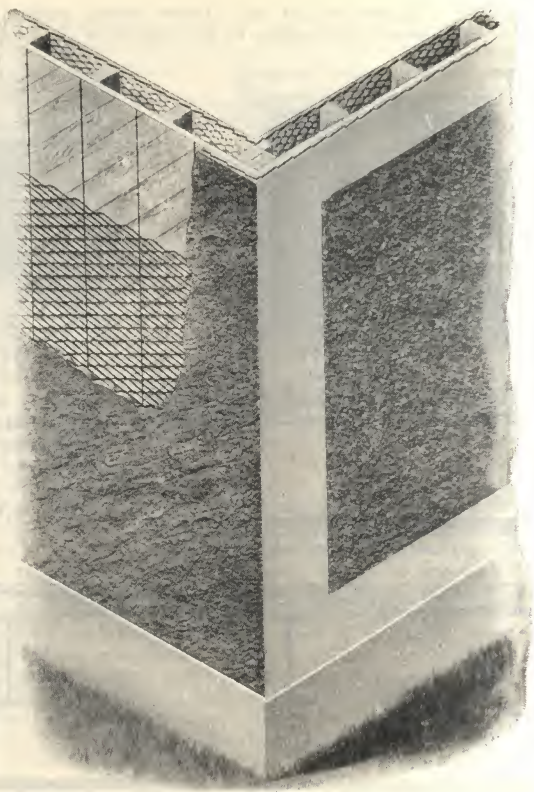


FIGURE 36

The following proportions have been used for a number of years with entire satisfaction:

The scratch coat should be mixed in the proportions of 1 part Portland cement, 3½ parts sand and ½ part hair putty.

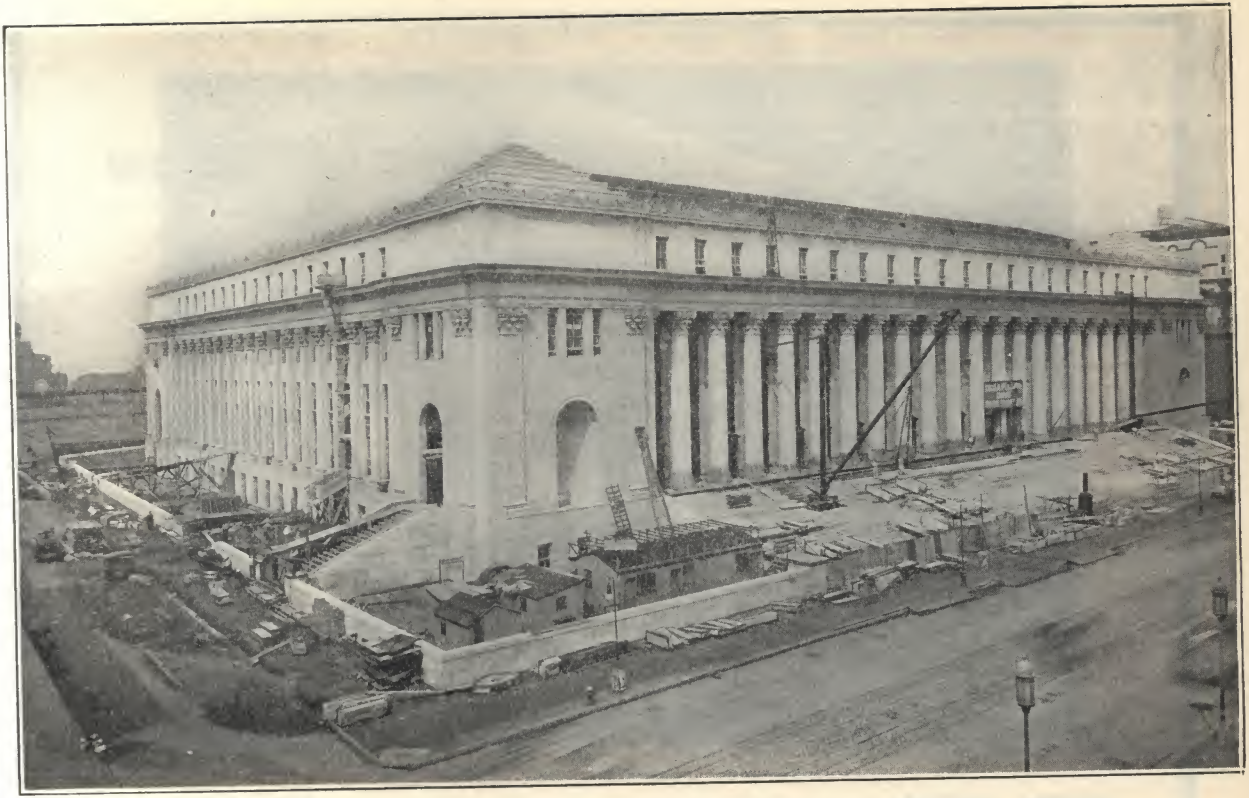
Mixture and Finish

The second coat should be mixed in the proportions of 1 part Portland cement to 3 parts sand, and the finish coat in the proportions of 1 part Portland cement to 2 parts sand. Lime putty, not exceeding 5 per cent, is often used to advantage in the finish coat. Where a total thickness of not more than one inch of cement mortar is required, it is practicable to apply it in two coats, the last coat to consist of one part cement to two of sand, which should be applied as soon as the first coat shall have set sufficiently to take the second coat. This will guarantee a bonding of the two applications. The finished appearance may be varied to suit the style of architecture desired, but should not be made to imitate anything else. With proper sand the finish coat may be colored. The surface may be smooth or rough. In fact, the architect finds an opportunity to diversify his art by the use of this construction and splendid effects are being produced.

This Photo shows the Walter Chess residence in Pittsburgh, Pa., erected in 1891. It was probably the first application of stucco on Metal Lath. Today, 21 years after, it is in perfect condition. Steelcrete A 24 gauge lath was used throughout.

998 Fifth Avenue, New York—Most luxurious apartment house in the world. 15,000 square yards Steelcrete A galvanized lath used. Lathers, Standard Metal Furring & Lathing Company. Architects, McKim, Mead & White.

Church St. Jean Baptiste, Cor. 76th St. & Lexington Ave., New York. 12,000 square yards Steelcrete Diamond galvanized lath used. Lather, Arthur Greenfield, Inc. Architect, N. Serracino.



THE NEW YORK POST OFFICE, 8TH AVE., 31ST & 33D STS.

Nearly 35,000 square yards of Steelcrete, A 22 U. S. gauge galvanized lath used.

CEILING IN HOUSE OF REPRESENTATIVES, HARRISBURG, PA.

Steelcrete Expanded Metal Lathing used. Architect, Joseph M. Huston, Philadelphia, Pa.

Liquid Contents. The tables in this pamphlet may be used only when the tank is intended to contain water or a lighter liquid. When it is desired to design a tank for any liquid heavier than water the following tables do not apply.

Introduction To Tables. The figures given in these tables designate in an abbreviated form the size of "Steelcrete" mesh required as a reinforcement in the vertical wall of the tank. For convenience these are given here:

075	designates	mesh	------3-13-075	35	designates	mesh	---------3-9-35
10	"	"	------3-13-10	40	"	"	---------3-6-40
125	"	"	------3-13-125	45	"	"	---------3-6-45
15	"	"	------3-9-15	50	"	"	---------3-6-50
20	"	"	------3-9-20	55	"	"	---------3-6-55
25	"	"	------3-9-25	60	"	"	---------3-6-60
30	"	"	------3-9-30				

For standard size of sheets, weight per square foot and other details of each size of mesh, page 33 of "Steelcrete" hand-book should be consulted.

Let it be required to design a circular tank of 20 feet internal diameter and inside depth of 20 feet. It is desired to know the reinforcement in the same and the thickness of the outer shell. From table 1, page 116, there is obtained the following data:—

Circular Tanks.

¼ - 075
30
50
40 - 40

The first line ¼ - 075 gives the fractional part of the sheet, constituting the top layer of reinforcement, which in this case is 3-13-075. The second line gives the size of the next reinforcing sheet 3-9-30. The third line gives the next size sheet 3-6-50. The last line calls for two sheets of mesh 3-6-40 at the bottom of the wall. The correct position of the reinforcement is shown in Figure 37. It should be remembered that the width of the sheet (the short direction of the diamonds) is the vertical direction of the sheet in the outer shell and the length of the sheet (indicated by the long direction of the diamonds) is the horizontal direction of the sheet. The sheets of mesh should be lapped eight inches or more, as the case may be, on the ends, and three inches or more on the sides.

Let it now be required to ascertain the thickness of the outer shell. From table 2, the thickness given in inches of a tank 20 feet in diameter and 20 feet in depth is 8 inches. The thickness at the top is in every case 4 inches. The inside face of the wall may be battered as shown in Figure 37, or be stepped off in even inches at the height indicated in the table. It may even be deemed expedient at times to make the wall of even thickness throughout.

Details.

The details of a circular tank will be noted from Figures 37 and 38. The thickness of the floor of a tank resting on hard ground should be equal to the thickness of the outer wall at the bottom, as given in table 2 except that it need not be more than six inches on

good foundation. Referring to Figure 38, the dimensions A and B should be all equal to the thickness of the outer wall at the bottom with the limitation on dimensions B as noted above.

The floor of the tank may be made monolithic, in which case it should be reinforced as shown in Figure 37 with "Steelcrete" mesh 3-13-075. The side walls should be securely tied to the floor, as indicated in the same figure, with 3-9-20, except that where the lower layer of mesh on the side walls is of a lighter size, that same size may be used for this purpose.

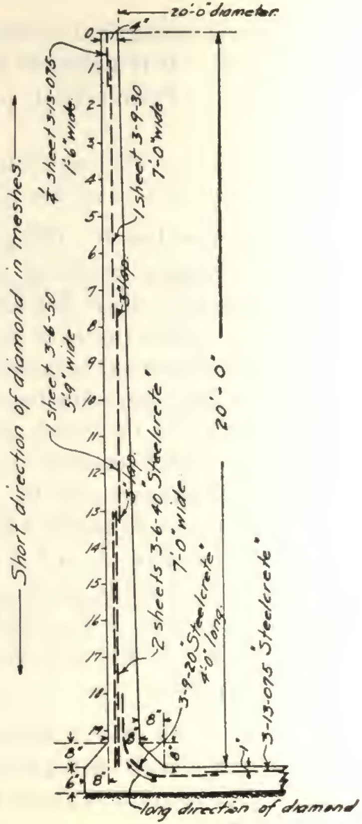


FIGURE 37.

Details of Construction.

The life and efficiency of a concrete tank depend upon its impermeability or resistance to leakages. Whether water-proofing compounds are used or not, no detail is more important to observe than that all the concrete should be poured in as nearly one operation as possible. If it is not possible to do this in one operation, the floor should be made in one and the outer shell in another. This is of so great importance that the designer should not hesitate to insist on day and night work to attain this end. This brings us to the subject of waterproofing.

Water-proofing.

The concrete should contain no stone larger than three-quarters of an inch in any dimension and the material should be carefully graded so that all voids will be well filled. Good concrete is the cheapest and best waterproofing. It has been demonstrated that a properly proportioned and properly mixed concrete may be made practically waterproof. It is nevertheless advisable to take every precaution possible. The concrete should be thoroughly mixed to a wet consistency and well tamped. Any good waterproofing compound which may be obtained in the market should be mixed with the concrete. The inside of the tank should be plastered with cement mortar or grouted with neat cement.

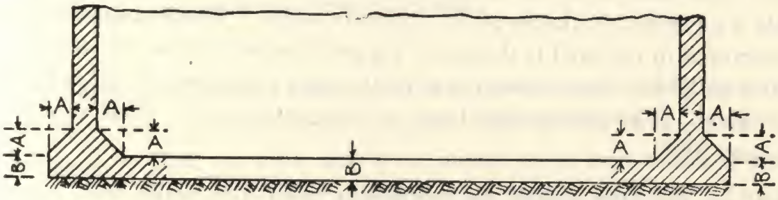


FIGURE 38.

Types of Tanks.

If a tank is required to be elevated as on a roof or water tower, the walls may be designed with the use of the tables, as given herewith. The floor, however, becomes a special design and here the services of an engineer should be sought.

If a tank is to be sunk in the ground, the tables herewith given may be used to aid in the design. The external earth pressure counteracts the internal pressure and serves to give

the tank additional stability when the tank is full. When the tank is empty the external pressure may reverse the stresses in the wall. In every case, therefore, two sheets of reinforcement should be used, one placed near the outer surface and the other near the inner one. The size of mesh near each surface may be of half the weight of the size called for in the tables; for example, if 3-6-40 is required, two sheets of 3-9-20 placed as stated above should be used. This rule will apply only for tanks up to 20 feet internal diameter. For tanks of greater internal diameter, the design is somewhat complicated, and it is recommended that the reinforcement called for in the tables should be placed near one surface and a like amount near the other surface of the wall.

How to Design a Square Tank.

In table 3 the size of mesh required to reinforce the walls of a square tank is given. Table 4 gives the thickness of the concrete walls. The arrangement and location of the reinforcement in the wall is shown in Figure39, which shows the details of a tank 10 feet square and 10 feet deep, designed with the data contained in tables 3 and 4. The data given in table 3 is an abbreviated form of designating the "Steelcrete" meshes as explained on page 108.

Details.

The floor of the tank should be monolithic with the walls and reinforced with "Steelcrete" 3-13-075 bent up into the side walls as shown. The thickness of the base should not be less than 4 inches, and need not be over 6 inches, governed by the thickness of the side walls.

The corners should be filleted as shown. Square inside corners are an element of weakness in reinforced concrete tanks. The extra cost of the form work required by the method shown will be amply repaid by the additional stability attained.

The ends of sheets should be lapped eight inches (one diamond) or more. The reinforcement should be continuous around the outer face.

As in the case of circular tanks, to attain the greatest security against leaking, the concrete should be poured in one operation. The ingredients should be selected carefully, proportioned well and tamped thoroughly.

Construction.

Where the tank is elevated above the ground, the base must be designed as a floor slab. The services of an engineer should be obtained for this.

Special Cases.

As in the case of circular tanks, square tanks depressed in the ground may be designed by the use of the tables. The same amount of reinforcement should be used continuously near the inside face of the side walls that is required near the outside face. There will thus be two layers of reinforcement instead of one.

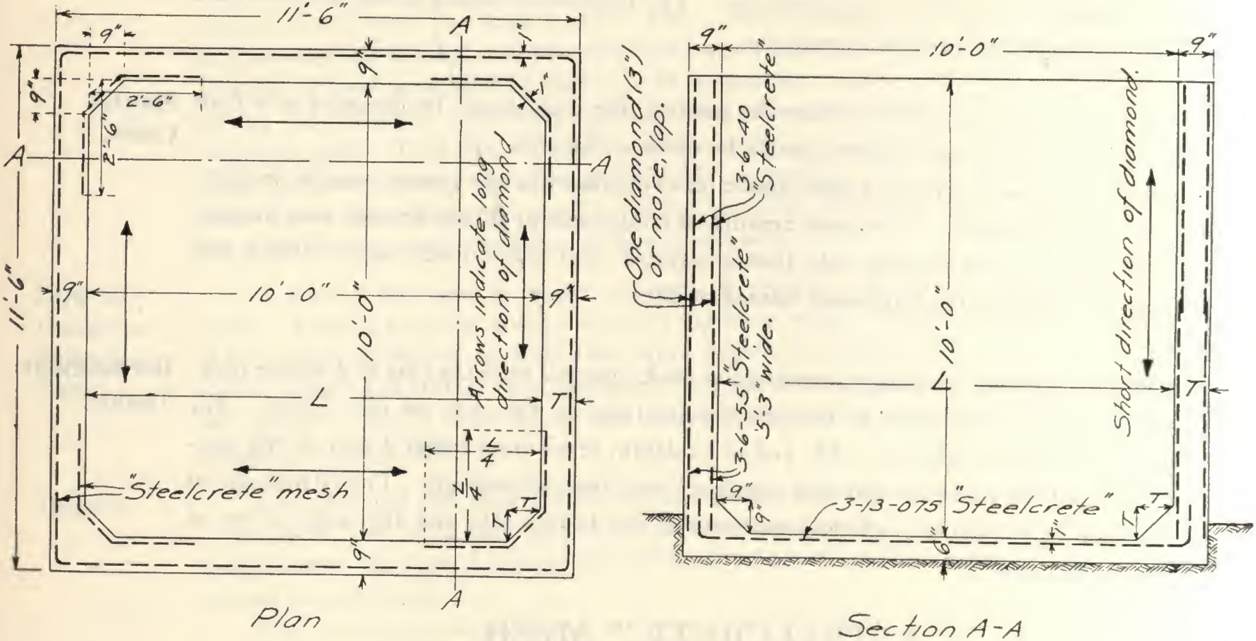
When it is desired to design a rectangular tank, proceed as in the case of a square tank, using the longest dimension of the rectangular tank as the side of the square. For example, to design a tank 10′ x 14′ and 6′ in depth, select from tables 3 and 4 the proportions of a tank 14 feet square and construct your tank accordingly. The 10 foot side of tank should be reinforced with the same mesh as the 14 foot side and the walls to be of the same thickness.

Rectangular Tanks.

"STEELCRETE" MESH.

In ordering "Steelcrete" mesh, full size sheets should be ordered, the standard sizes of which are given on page 33

How to Order.



11'-6"
9"
A
1"
9"
9"
2'-6"
2'-6"
1"
A
A
11'-6"
9"
10'-0"
10'-0"
9"
Arrows indicate long direction of diamond
L
T
L/4
L/4
"Steelcrete" mesh
T
T
9"
A
Plan
9"
10'-0"
9"
One diamond (3") or more, lap.
3-6-40 "Steelcrete"
10'-0"
Short direction of diamond.
3-6-55 "Steelcrete" 5'-3" wide.
L
T
9"
9"
3-13-075 "Steelcrete"
T
T
1"
6"
Section A-A

FIGURE 39

Table 1.—CIRCULAR TANKS

"Steelcrete" Expanded Metal Mesh required to reinforce the outer vertical wall.

Inside depth in feet	Inside diameter in feet at the top: 5	10	15	20	25	30	35	40	45	50	55	60
5	075	10	15	20	30	30	35	40	45	50	55	55
6	075	¼-075 125	¼-075 20	½-075 25	30	35	40	45	¼-125 55	¼-15 60	35-35	35-35
7	¼-075 075	15	½-075 20	30	¼-075 35	40	¼-10 50	¼-15 50	½-20 60	¼-125 35-35	40-40	40-40
8	½-075 075	¼-075 15	125 25	¼-075 30	¼-075 40	½-125 45	25 55	25 60	½-20 35-35	¼-125 40-40	½-25 45-45	½-25 45-45
9	½-075 10	½-075 15	½-075 30	½-15 35	½-15 45	25 55	¼-25 25 60	25 35-35	½-20 40-40	½-30 45-45	½-30 50-50	½-40 50-50
10	075 125	125 20	½-10 30	½-15 40	20 50	30 60	25 35-35	25 40-40	25 45-45	50 50-50	45 50-50	35-35 60-60
11	075 125	15 20	125 30	20 45	30 55	40 60	25 40-40	35 45-45	45 50-50	50 50-50	½-20 60 60-60	
12	¼-075 075 125	¼-075 15 25	15 35	½-075 25 45	¼-10 35 60	35 35-35	35 40-40	45 45-45	¼-15 55 50-50	¼-15 35-35 60-60		
13	½-075 075 125	½-075 15 25	15 40	¼-075 30 50	¼-10 40 60	35 40-40	¼-10 50 45-45	½-20 55 50-50	25 35-35 60-60			
14	¼-075 075 15	10 20 25	½-075 20 40	½-15 35 55	¼-075 40 35-35	40 40-40	20 55 50-50	25 60 50-50				
15	½-075 075 15	¼-075 15 30	125 25 45	125 40 60	½-15 45 35-35	½-15 50 45-45	35 60 50-50	25 40-40 60-60				
16	½-075 10 15	½-075 15 30	½-10 30 45	20 40 60	½-15 45 40-40	35 60 45-45	35 35-35 50-50					
17	075 15 20	15 20 35	125 30 50	20 45 35-35	20 50 40-40	40 60 50-50	35 40-40 60-60					

SEE PAGE 116

Table 1.—CIRCULAR TANKS (Continued)

"Steelcrete" Expanded Metal Mesh required to reinforce the outer vertical wall.

Inside depth in feet	Inside diameter in feet at the top. 5	10	15	20	25	30	35	
18	½-075 075 125 20	½-10 20 25 35	½-10 20 35 50	½-075 25 45 35-35	¼-10 35 60 45-45	40 35-35 50-50 —		
19	¼-075 075 15 20	½-075 15 25 35	½-075 20 40 55	¼-075 30 50 35-35	½-075 40 60 45-45	¼-10 40 40-40 60-60		
20	½-075 075 15 20	½-075 15 25 40	15 25 45 60	¼-075 30 50 40-40	½-125 40 35-35 50-50	25 50 45-45 60-60		
21	½-075 10 15 20	10 20 25 40	½-10 30 45 60	½-15 35 55 40-40	20 45 35-35 50-50			
22	10 15 20 25	½-075 15 30 45	15 35 50 60	20 40 60 45-45	20 45 40-40 50-50			
23	½-075 075 15 20 25	15 20 35 45 —	15 35 50 35-35 —	20 45 35-35 45-45 —	¼-075 40 60 45-45 60-60			
24	½-075 075 15 20 25	½-075 15 25 35 50	¼-075 20 40 55 35-35	½-075 25 45 35-35 45-45	½-15 45 60 45-45 60-60			
25	½-075 10 15 20 25	075 20 25 40 50	½-10 20 40 55 35-35	½-075 35 50 35-35 50-50				

Table 2.—CIRCULAR TANKS

Total thickness of side walls in inches. 1: 2: 4: concrete.

Inside depth in feet	Inside diameter in feet at the top. 5'	10	15	20	25	30	35	40	45	50	55	60'
5'	4"	4	4	4	4	4	4	4	5	5	5	6"
6	4	4	4	4	4	4	4	5	5	6	6	7
7	4	4	4	4	4	4	5	5	6	7	7	8
8	4	4	4	4	4	5	5	6	7	8	8	9
9	4	4	4	4	5	5	6	7	8	9	9	10
10	4	4	4	4	5	6	7	8	9	9	10	11
11	4	4	4	4	5	6	7	8	9	10	11	
12	4	4	4	5	6	7	8	9	10	11		
13	4	4	4	5	6	7	9	10	11			
14	4	4	4	5	7	8	9	11				
15	5	5	5	6	7	9	10	11				
16	5	5	5	6	8	9	11					
17	5	5	5	7	8	10	11					
18	5	5	5	7	9	10						
19	5	5	6	7	9	11						
20	5	5	6	8	9	11						
21	5	5	6	8	10							
22	5	5	6	8	10							
23	5	5	7	9	11							
24	5	5	7	9	11							
25	5"	5	7	9								

Thickness of ring at top should not be less than 4".

Table 3.—SQUARE TANKS

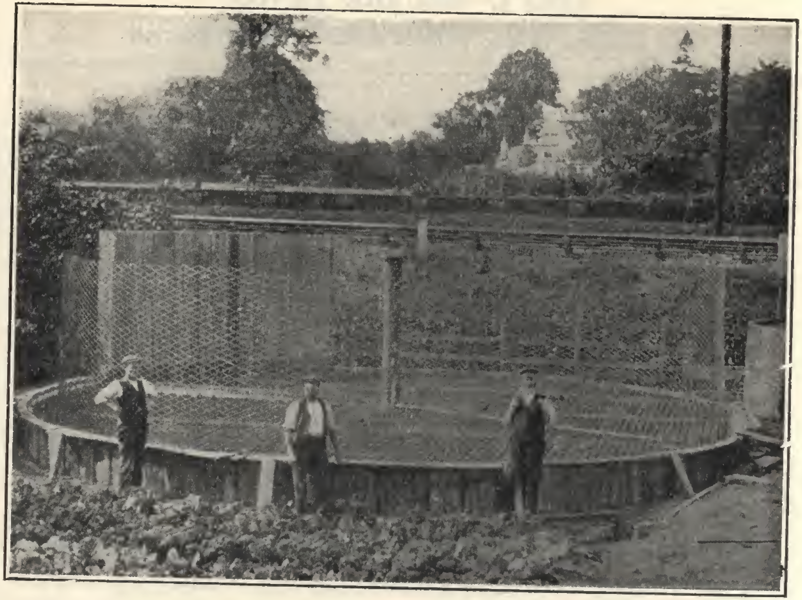
"Steelcrete" Mesh required in the side walls.

Inside depth in feet		Inside length in feet											
		4	5	6	7	8	9	10	11	12	13	14	15
	4	075	125	20	25	25	30	35	35	45	45	50	50
	5	10	20	20	30	30	30	35	45	45	55	55	
	6	15	$\frac{1}{4}$-075 20	$\frac{1}{2}$-10 25	30	35	35	45	45	$\frac{1}{4}$-25 55	$\frac{1}{4}$-25 55		
	7	15	$\frac{1}{2}$-10 25	$\frac{1}{2}$-15 25	30	40	40	$\frac{1}{4}$-15 45	$\frac{1}{2}$-25 55	$\frac{1}{2}$-25 55			
	8	$\frac{1}{2}$-075 20	125 25	20 25	$\frac{1}{2}$-125 35	$\frac{1}{4}$-10 40	$\frac{1}{2}$-20 45	25 50	$\frac{1}{2}$-35 55				
	9	125 25	$\frac{1}{2}$-075 30	$\frac{1}{2}$-10 30	25 35	25 45	25 45	$\frac{1}{2}$-30 50	35 60				
	10	15 25	$\frac{1}{2}$-10 30	20 35	20 40	25 45	30 50	40 55					
	11	$\frac{1}{2}$-075 20 25	125 30	20 35	20 40	35 45	35 55	40 60					
	12	$\frac{1}{2}$-10 20 25	20 30	30 35	30 45	40 50	40 55						
	13		$\frac{1}{2}$-075 25 30	$\frac{1}{2}$-15 25 35	30 45	$\frac{1}{4}$-10 40 55	$\frac{1}{2}$-20 45 60						
	14		125 25 35	$\frac{1}{2}$-15 25 40	$\frac{1}{2}$-125 35 45	25 45 55							
	15		$\frac{1}{2}$-075 30 35	20 25 40	25 35 45	25 45 55							

Table 4.—SQUARE TANKS

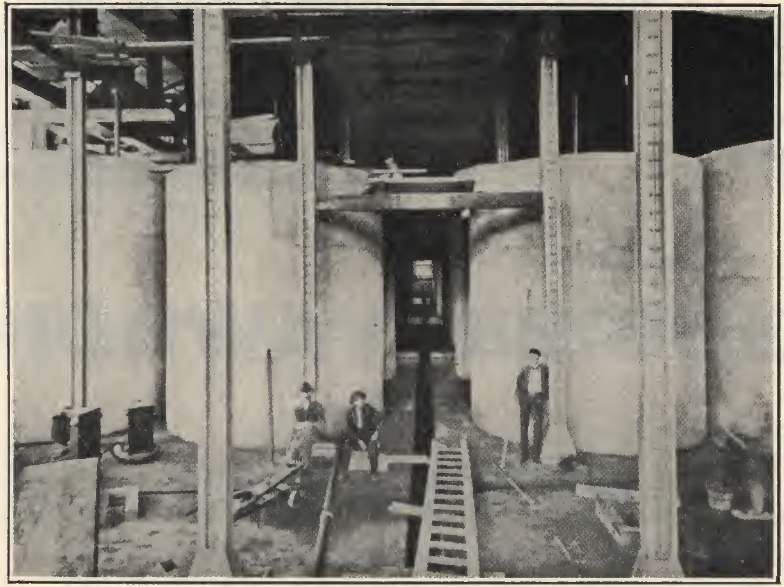
Total thickness of side walls in inches. 1: 2: 4: concrete.

Inside depth in feet.	Inside length in feet.											
	4	5	6	7	8	9	10	11	12	13	14	15
4	5	5	5	5	6	6	6	7	7	8	8	9
5	5	5	5	6	6	7	7	7	8	8	9	
6	5	5	5	6	6	7	7	8	8	9		
7	5	5	6	6	7	7	8	8	9			
8	5	5	6	6	7	8	8	9				
9	5	5	6	7	7	8	9	9				
10	5	6	6	7	8	8	9					
11	5	6	6	7	8	8	9					
12	5	6	7	7	8	9						
13		6	7	8	8	9						
14		6	7	8	9							
15		6	7	8	9							



Steelcrete Expanded Metal reinforced concrete tank.

This illustration shows the tank in course of construction, ready for the forms. Note the stiffness of the sheets, guaranteeing a perfect distribution of the steel.



The illustration herewith shown is made from a photograph taken in the plant of the Oxford Paper Company at Rumford Falls, Maine.

These tanks, thirty in number, average 20 feet in height and 14 feet in diameter. In their construction both economy and durability were accomplished. They were made at a less price than had previously been paid for wood tanks for the same purpose which were the kind in universal use in paper mills. Up to this time, nearly eleven years after their construction, they have proven in every way satisfactory as the letter on next page will show:—

OXFORD PAPER COMPANY,

GENERAL OFFICES:
200 FIFTH AVENUE, NEW YORK.

Rumford, Maine, July 29, 1912

Eastern Expanded Metal Co.,

201 Devonshire St.,

Boston, Mass.

Gentlemen:

Replying to your letter of July 5th., regarding concrete tanks which were built for us when the mill was constructed, would say that these tanks have given us first class satisfaction.

Yours very truly,

OXFORD PAPER COMPANY.

By

Fred J. Latham

Engineer.

W.S.

INTRODUCTION

The plans and data in the sketches embodied in this pamphlet are self explanatory. Examples are given of the standards adopted by the State and Town Highway Commissions of New York and of the Pennsylvania State Highway Department. Also examples are given of all-reinforced concrete culverts, including different designs of wing or head walls, floor systems and other details. This will enable an inquirer to select a design in accordance with his special needs. Attention is called to the quantities of material in most cases given, which have been prepared with painstaking care. These quantities, we believe, will be found of great help in comparing costs.

In New York State and Town Highway Standards reference is made to 2nd and 3rd class concrete. The following extract from the specifications is explanatory:

"Concrete will be classified as follows: First-class, second-class, third-class.

"First-class concrete shall be made of 1 part Portland cement, 2 parts clean sand or crusher dust, resulting from the breaking of hard trap, hard sandstone, granite or gneiss, and four parts of crushed stone, all measured in loose bulk in boxes or forms of known capacity satisfactory to the engineer.

"Crushed stone for first-class concrete shall be trap, granite or gneiss, satisfactory to the Commission.

"Second-class concrete shall be made of 1 part Portland cement, 2½ parts of clean, approved sand or crusher dust, and 5 parts of crushed stone or screened washed gravel if permitted by the Engineer, all measured in loose bulk in boxes or forms of known capacity satisfactory to the Engineer.

"Third-class concrete shall be made of 1 part Portland cement, 3 parts clean, approved sand or crusher dust, and 6 parts of crushed stone, all measured in loose bulk as aforesaid."

"STEELCRETE" DECIMAL STANDARDS

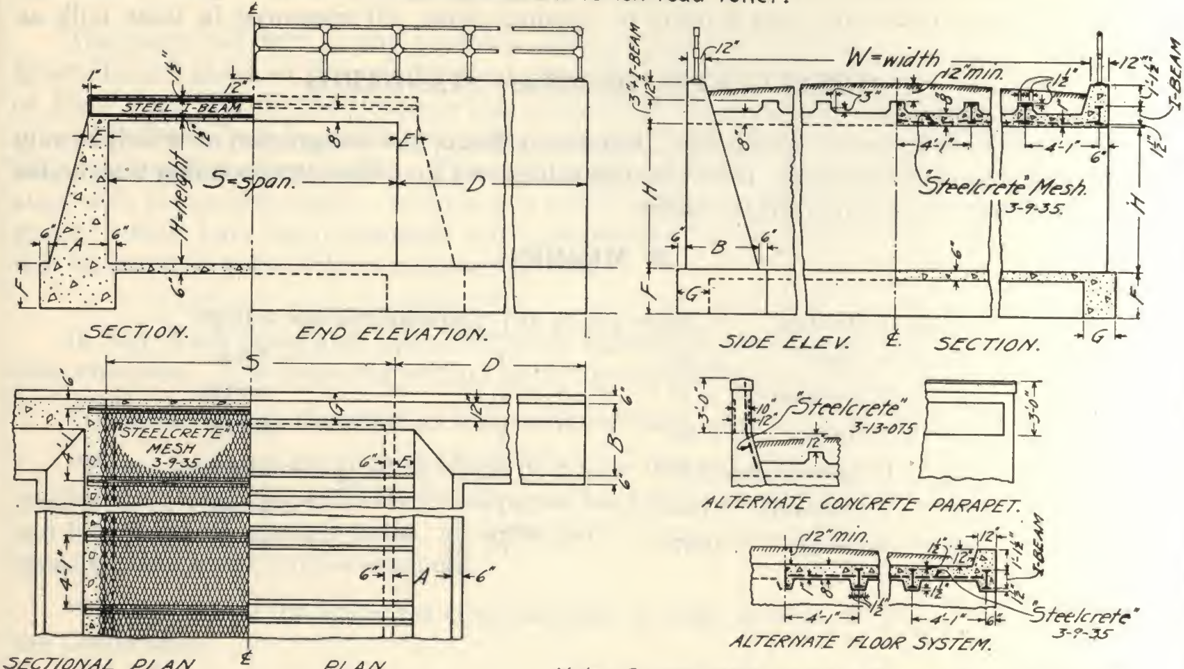
If it is desired to order "Steelcrete" Expanded Metal, the designation of which is only known under the old standards, the following tables will give the corresponding size under the decimal standards at present in vogue:

3" MESHES

3" No. 13 Standard	(.28 lbs per sq. ft.)	Corresponding size	3-13-075
3" " 10 Light	(.50 " " " ")	" "	3-9-15
3" " 10 Standard	(.60 " " " ")	" "	3-9-175
3" " 10 Heavy	(.90 " " " ")	" "	3-9-25
3" " 10 Extra Heavy	(1.20 " " " ")	" "	3-9-35
3" " 6 Standard	(1.38 " " " ")	" "	3-6-40
3" " 6 Heavy	(2.07 " " " ")	" "	3-6-60

HIGHWAY I-BEAM BRIDGES—RIGHT ANGLED WING WALLS.

Maximum load one 15 ton road roller.



Note:- Concrete 1:3:5 mixture. Floor only, 1:2:5 mixture.
Round all exposed edges to a 1½" radius.
Pile foundations to be used in light or shifting soils.
Width W depends upon depth of fill on the top and the width of the roadway.

HIGHWAY I-BEAM BRIDGES – RIGHT ANGLED WING WALLS.

Maximum load one 15 ton road roller.

DIMENSIONS.

H =	A	B	D
4'	2'-0"	2'-9"	9'-0"
6	2'-5"	3'-6"	12'-0"
8	3'-3"	4'-6"	15'-0"
10	4'-0"	5'-3"	18'-0"
12	4'-10"	6'-0"	21'-0"
14	5'-8"	6'-9"	24'-0"
16	6'-5"	7'-6"	27'-0"
18	7'-3"	8'-6"	30'-0"
20'	8'-0"	9'-3"	33'-0"

DIMENSIONS.

SPAN.	E.
8'-0" to 16'-0"	1'-1"
18'-0" to 28'-0"	1'-6"
30'-0" to 38'-0"	2'-0"

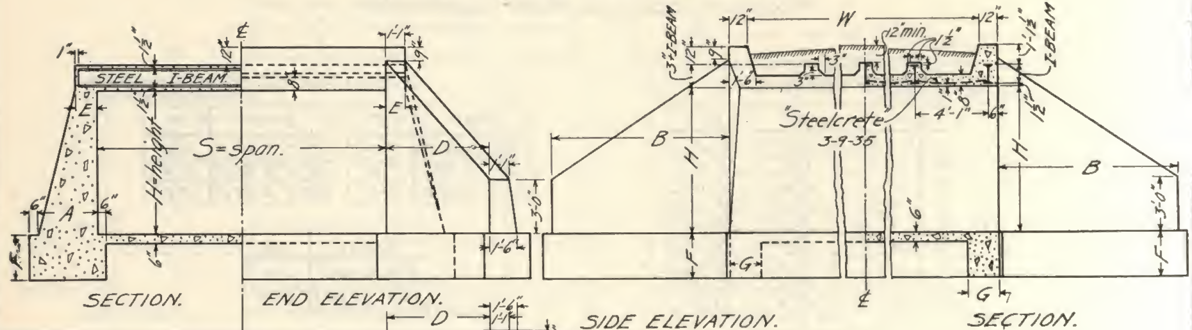
SPAN.	F.
8'-0" to 16'-0"	2'-0"
18'-0" to 28'-0"	2'-6"
30'-0" to 38'-0"	3'-0"

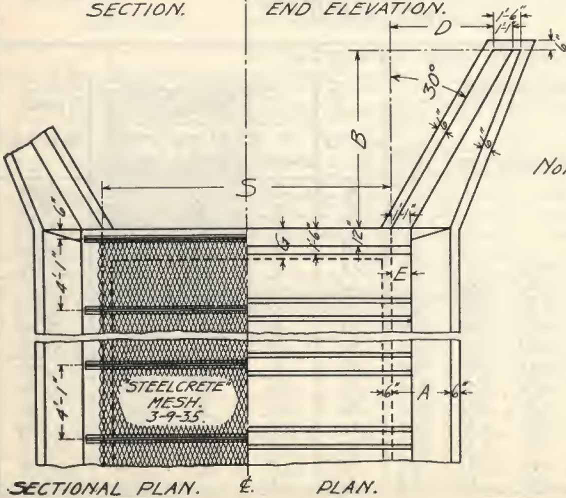
SPAN.	G.
8'-0" to 18'-0"	1'-6"
20'-0" to 38'-0"	2'-0"

S SPAN.	DIMENSIONS. I-BEAMS.				QUANTITIES FOR W = 15'-4". CUBIC YARDS CONCRETE. 1:3:5 H =										"STEELCRETE." 3-9-35.			LBS.
	NO. FOR W=15'-4"	SIZE	WGT. PER FT.	LENGTH.	4'	6	8	10	12	14	16	18	20'	1:2:5	NO. OF SHEETS	STAND. SIZE	TOTAL SQ. FT.	I-BEAMS.
8'	5	10"	25#	10'-0"	40	67	110							6	3	6'-0" wide by 8'-0" long.	144	1250
10'	"	12"	31½#	12'-0"	41	68	111	164						8	4		192	1890
12'	"	12"	35#	14'-0"	42	69	112	165	233					9	4		192	2450
14'	"	12"	40#	16'-0"	43	70	113	166	234	319				10	5		240	3200
16'	"	15"	42#	18'-0"	45	72	115	168	236	321	422			13	6		288	3780
18'	"	15"	45#	20'-10"	51	80	125	182	252	340	444	580		14	6		288	4687
20'	"	15"	50#	22'-10"	54	83	128	184	254	342	446	582	730	16	7		336	5707
22'	"	18"	60#	24'-10"	56	86	132	188	259	347	453	589	738	18	8		384	7449
24'	"	18"	65#	26'-10"	57	87	133	189	260	348	454	590	739	20	8		384	8720
26'	"	18"	70#	28'-10"	58	88	134	190	261	349	455	591	740	21	9		432	10090
28'	"	20"	70#	30'-10"	60	90	135	192	264	352	458	594	744	24	10		480	10790
30'	"	20"	75#	33'-10"	68	99	148	207	282	372	481	622	775	26	10		480	12686
32'	"	24"	85#	35'-10"	70	102	151	211	286	377	489	630	785	30	11		528	15228
34'	"	24"	90#	37'-10"	72	104	153	213	288	379	491	632	786	32	12		576	17023
36'	"	24"	95#	39'-10"	73	105	154	214	290	381	492	633	787	33	12		576	18919
38'	"	24"	100#	41'-10"	74	106	155	215	291	382	493	634	788	35	13		624	20915

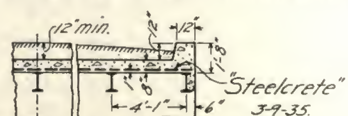
HIGHWAY I-BEAM BRIDGES—SKEWED WING WALLS.

Maximum load one 15 ton road roller.





Note:- Concrete 1:3:5 mixture. Floor only, 1:2:5 mixture.
Round all exposed edges to a 1½" radius.
Pile foundations to be used in light or shifting soils.
Width **W** depends upon depth of fill on the top and the width of the roadway.
Alternate floor system and concrete parapet may be used as given with RIGHT ANGLED WING WALLS.



ALTERNATE FLOOR SYSTEM.
May also be used with RIGHT ANGLED WING WALLS.

HIGHWAY I-BEAM BRIDGES-SKEWED WING WALLS.

Maximum load one 15 ton road roller.

DIMENSIONS.

H=	A	B	D
4'	2'-0"	5'-3"	3'-0"
6	2'-5"	8'-3"	4'-9"
8	3'-3"	11'-3"	6'-6"
10	4'-0"	14'-3"	8'-3"
12	4'-10"	17'-3"	10'-0"
14	5'-8"	20'-3"	11'-9"
16	6'-5"	23'-3"	13'-5"
18	7'-3"	26'-3"	15'-2"
20'	8'-0"	29'-3"	16'-10"

DIMENSIONS.

SPAN.	E.
8'-0" to 16'-0"	1'-1"
18'-0" to 28'-0"	1'-6"
30'-0" to 38'-0"	2'-0"

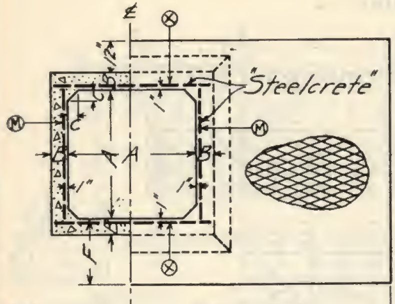
SPAN.	F.
8'-0" to 16'-0"	2'-0"
18'-0" to 28'-0"	2'-6"
30'-0" to 38'-0"	3'-0"

SPAN.	G
8'-0" to 18'-0"	1'-6"
20'-0" to 38'-0"	2'-0"

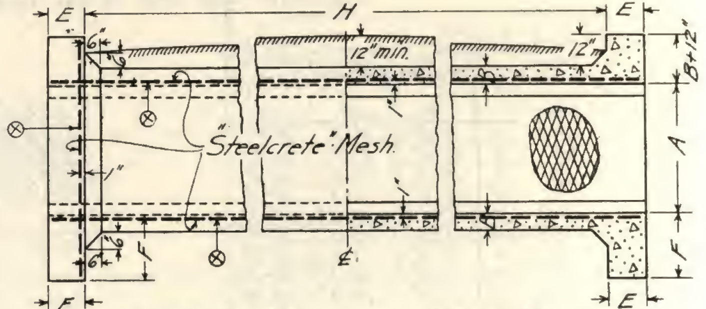
S SPAN.	DIMENSIONS. I-BEAMS.				QUANTITIES FOR W=15'-4". CUBIC YARDS CONCRETE. 1:3:5 H=										"STEELCRETE." 3-9-35.			LBS.
	NO. FOR W=15'-4"	SIZE	WGT. PER FT.	LENGTH	4'	6	8	10	12	14	16	18	20'	1:2:5	NO. OF SHEETS	STAND. SIZE.	TOTAL SQ. FT.	I-BEAMS.
8'	5	10"	25#	10'-0"	29	44	67							6	3	6'-0" wide by 8'-0" long.	144	1250
10'	"	12"	31½#	12'-0"	30	45	68	98						8	4		192	1890
12'	"	12"	35#	14'-0"	31	46	69	99	137					9	4		192	2450
14'	"	12"	40#	16'-0"	32	47	70	100.	138	184				10	5		240	3200
16'	"	15"	42#	18'-0"	33	48	72	102	139	186	239			13	6		288	3780
18'	"	15"	45#	20'-10"	39	56	81	113	154	203	259	326		14	6		288	4687
20'	"	15"	50#	22'-10"	42	58	84	116	156	205	261	329	405	16	7		336	5707
22'	"	18"	60#	24'-10"	43	60	85	117	158	207	264	331	408	18	8		384	7449
24'	"	18"	65#	26'-10"	44	61	87	119	160	209	265	333	409	20	8		384	8720
26'	"	18"	70#	28'-10"	45	62	88	120	161	210	266	334	410	21	9		432	10090
28'	"	20"	70#	30'-10"	47	64	90	121	163	212	268	336	413	24	10		480	10790
30'	"	20"	75#	33'-10"	54	73	101	135	179	231	290	366	441	26	10		480	12686
32'	"	24"	85#	35'-10"	56	75	103	138	181	234	293	370	444	30	11		528	15228
34'	"	24"	90#	37'-10"	57	76	104	139	183	235	295	371	446	32	12		576	17023
36'	"	24"	95#	39'-10"	59	77	106	140	184	237	296	372	447	33	12		576	18919
38'	"	24"	100#	41'-10"	60	79	107	142	185	238	297	374	449	35	13		624	20915

HIGHWAY BOX CULVERTS.

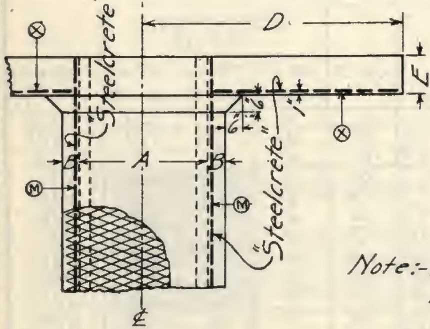
Maximum load 15 ton road roller.



SECTION END ELEV.



SIDE ELEV. SECTION.



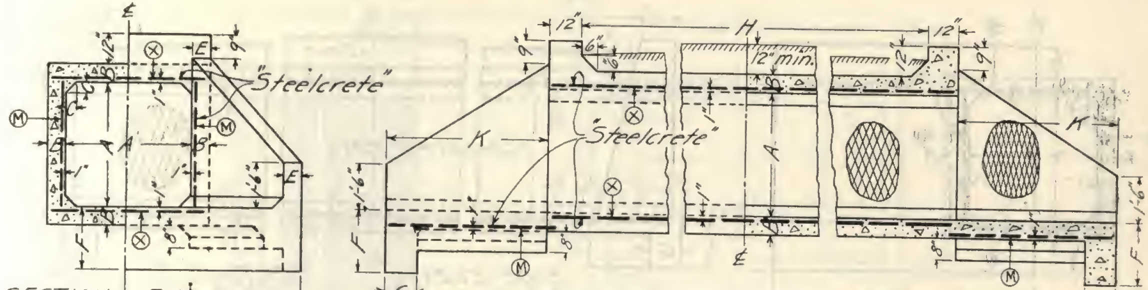
PLAN.

DIMENSIONS.								QUANTITIES FOR H = 16'-0"			
								"STEELCRETE"			CU. YDS. CONCRETE 1:2:5
SIZE.	A	B	C	D	E	F	"STEELCRETE" MESH.	NO. OF SHEETS	STAND. SIZE	TOTAL SQ. FT.	
2'x2'	2'-0"	6"	3"	4'-0"	6"	1'-6"	Ⓜ 3-13-10 ⊗ 3-9-30	1 3	6'-9"x12' 7'-0"x10'	81 210	$4\frac{1}{2}$
3'x3'	3'-0"	7"	3"	6'-0"	8"	1'-9"	Ⓜ 3-13-125 ⊗ 3-9-35	2 4	5'-3"x12' 6'-0"x12'	126 288	$8\frac{1}{2}$
4'x4'	4'-0"	8"	4"	8'-0"	12"	2'-0"	Ⓜ 3-9-15 ⊗ 3-6-40	2 5	7'-0"x12' 7'-0"x12'	168 420	$15\frac{3}{4}$

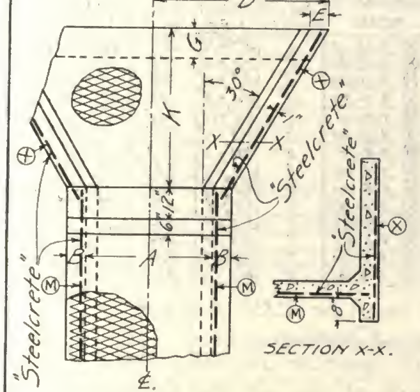
Note:- All concrete 1:2:5 mixture.
Round all exposed edges to a $1\frac{1}{2}$" radius.
Pile foundations to be used in light or shifting soils.
Distance H depends upon depth of fill on the top and the width of the roadway.

HIGHWAY BOX CULVERTS.

Maximum load 15 ton road roller.



SECTION. END ELEV. SIDE ELEV SECTION.



SECTION X-X.

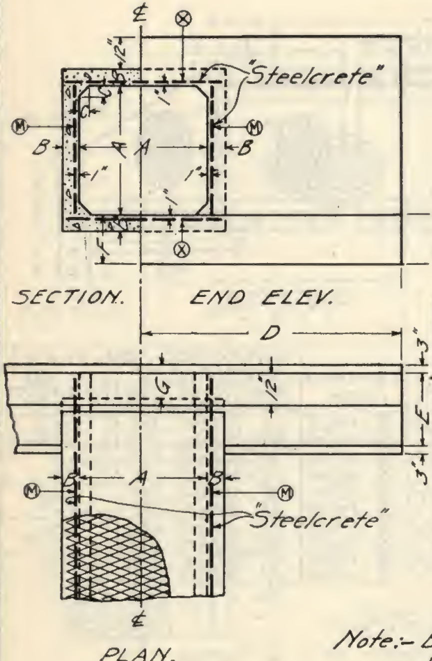
PLAN

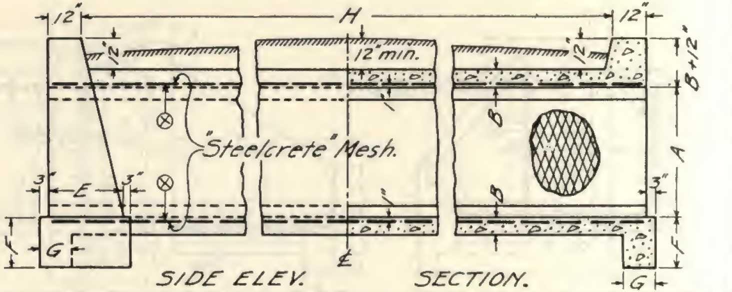
SIZE	A	B	C	D	E	F	G	K	"STEELCRETE" MESH.	NO. OF SHEETS	STAND. SIZE.	TOTAL SQ. FT.	CU. YDS. CONCRETE. 1:2:5
DIMENSIONS.										QUANTITIES FOR H=16'-0". "STEELCRETE"			
4'×4'	4'-0"	8"	4"	5'-8"	8"	2'-0"	1'-0"	5'-2"	Ⓜ 3-9-15 ⊗ 3-6-40	4 5	7'-0"×12' 7'-0"×12'	336 420	14½
5'×5'	5'-0"	9"	5"	7'-2"	9"	2'-0"	1'-0"	6'-9"	Ⓜ 3-9-15 ⊗ 3-6-45	5 7	7'-0"×10' 6'-3"×12'	350 525	21
6'×6'	6'-0"	10"	6"	8'-8"	10"	2'-0"	1'-0"	8'-5"	Ⓜ 3-9-20 ⊗ 3-6-50	8 13	5'-3"×12' 5'-9"×8'	504 598	29½
7'×7'	7'-0"	11"	7"	10'-3"	11"	2'-3"	1'-3"	10'-0"	Ⓜ 3-9-20 ⊗ 3-6-55	15 17	5'-3"×8' 5'-3"×8'	630 714	41
8'×8'	8'-0"	12"	8"	11'-9"	12"	2'-3"	1'-3"	11'-8"	Ⓜ 3-9-20 ⊗ 3-6-60	17 17	5'-3"×8' 4'-9"×12'	714 969	53

Note:- All concrete 1:2:5 mixture.
Round all exposed edges to a 1½" radius.
Pile foundations to be used in light or shifting soils.
Distance H depends upon depth of fill on the top and the width of the roadway.

HIGHWAY BOX CULVERTS.

Maximum load 15 ton road roller.

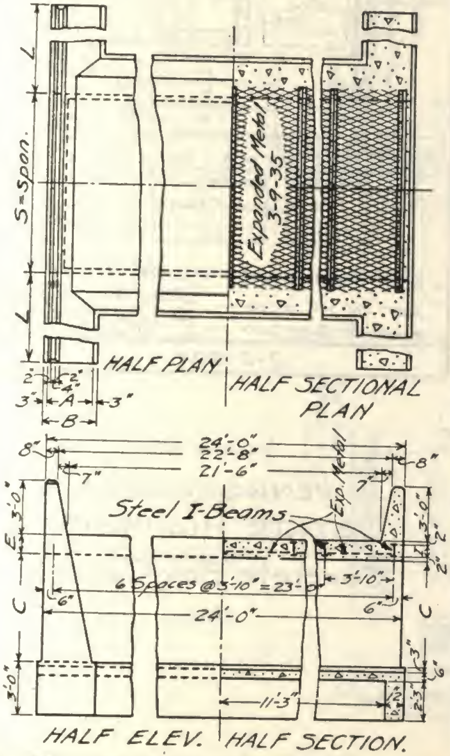


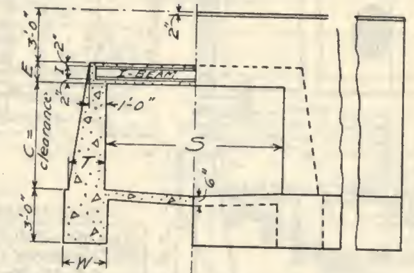


DIMENSIONS.									QUANTITIES FOR H=16'-0".					
									"STEELCRETE"			CU. YDS. CONCRETE.		
SIZE.	A	B	C	D	E	F	G	"STEELCRETE" MESH.	NO. OF SHEETS.	STAND. SIZE.	TOTAL SQ. FT.	1:2:5	1:3:5	TOTAL
2'x2'	2'-0"	6"	3"	4'-0"	1'-6"	1'-0"	9"	Ⓜ 3-13-10 ⓧ 3-9-30	1 2	6'-9"x12' 7'-0"x10'	81 140	$3\frac{3}{4}$	$2\frac{1}{2}$	$6\frac{1}{4}$
3'x3'	3'-0"	7"	3"	6'-0"	1'-10"	1'-0"	9"	Ⓜ 3-13-125 ⓧ 3-9-35	2 4	5'-3"x12' 6'-0"x8'	126 192	6	$5\frac{1}{4}$	$11\frac{1}{4}$
4'x4'	4'-0"	8"	4"	8'-0"	2'-3"	1'-6"	1'-0"	Ⓜ 3-9-15 ⓧ 3-6-40	2 3	7'-0"x12' 7'-0"x12'	168 252	9	11	20
5'x5'	5'-0"	9"	5"	10'-0"	2'-9"	1'-6"	1'-0"	Ⓜ 3-9-15 ⓧ 3-6-45	3 3	7'-0"x10' 6'-3"x12'	210 225	$12\frac{1}{4}$	18	$30\frac{1}{4}$
6'x6'	6'-0"	10"	6"	12'-0"	3'-1"	1'-6"	1'-0"	Ⓜ 3-9-20 ⓧ 3-6-50	4 7	5'-3"x12' 5'-9"x8'	252 322	$16\frac{1}{4}$	$26\frac{1}{4}$	$42\frac{1}{2}$
7'x7'	7'-0"	11"	7"	14'-0"	3'-6"	2'-0"	1'-6"	Ⓜ 3-9-20 ⓧ 3-6-55	7 7	5'-3"x8' 5'-3"x8'	294 294	$20\frac{1}{2}$	41	$61\frac{1}{2}$
8'x8'	8'-0"	12"	8"	16'-0"	4'-0"	2'-0"	1'-6"	Ⓜ 3-9-20 ⓧ 3-6-60	7 8	5'-3"x8' 4'-9"x12'	294 456	$25\frac{1}{2}$	$56\frac{1}{2}$	82

Note:- Box 1:2:5 mixture. End walls may be 1:3:5 mixture.
Round all exposed edges to a $1\frac{1}{2}$" radius.
Pile foundations to be used in light or shifting soils.
Distance H depends upon depth of fill on the top and the width of the roadway.

PENNSYLVANIA STATE HIGHWAYS
CONCRETE I-BEAM BRIDGES.
1910.

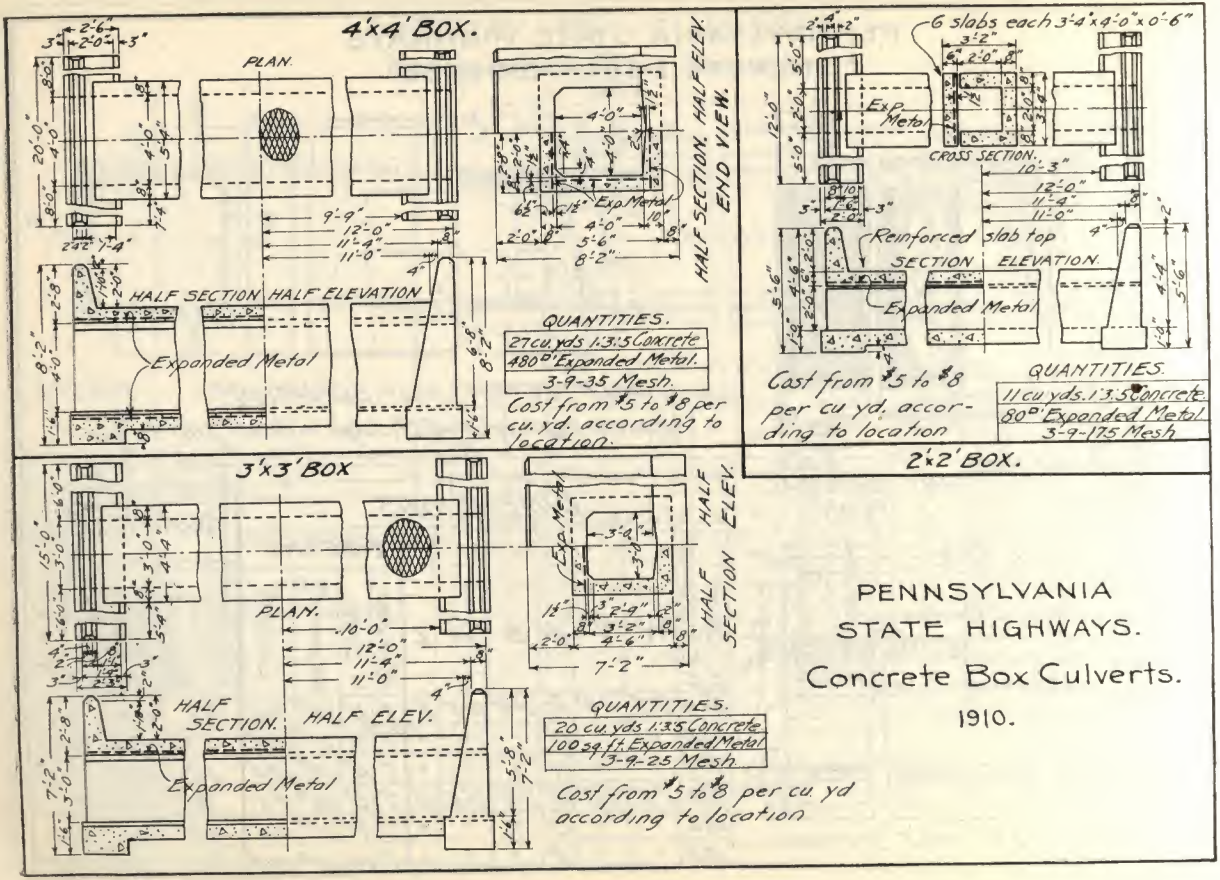




HALF SECTION. HALF ELEVATION.

Approx. cost of 8'x4' Bridge = from #300 to #500
" " " 12'x6' " " " #575 " #875

DIMENSIONS.											QUANTITIES.		
							I-BEAMS.						
Span Clearance. S C	W	T	E	B	A	L	Number.	Size. I	Wt. per Ft.	Length	Cu. Yds. 1:3:5 Concrete.	Pounds I-Beams.	Sq. Ft. Exp. Metal. 3-9-35
8'x4'	2'-3"	1'-9"	12"	2'-9"	2'-3"	8'	7	8"	18#	9'-4"	53	1176	215
10'x4'	"	"	13"	"	"	"	7	9"	21#	11'-4"	57	1666	305
12'x4'	"	"	14"	"	"	"	7	10"	25#	13'-4"	62	2333	360
8'x6'	2'-6"	2'-0"	12"	3'-0"	2'-6"	10'	7	8"	18#	9'-4"	70	1176	215
10'x6'	"	"	13"	"	"	"	7	9"	21#	11'-4"	84	1666	305
12'x6'	"	"	14"	"	"	"	7	10"	25#	13'-4"	90	2333	360



PENNSYLVANIA STATE HIGHWAYS.

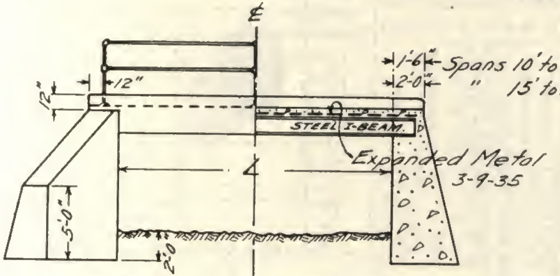
Concrete Box Culverts.

1910.

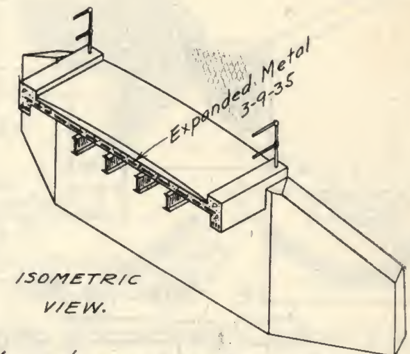
STATE OF NEW YORK—TOWN HIGHWAYS.

CONCRETE I-BEAM BRIDGES.

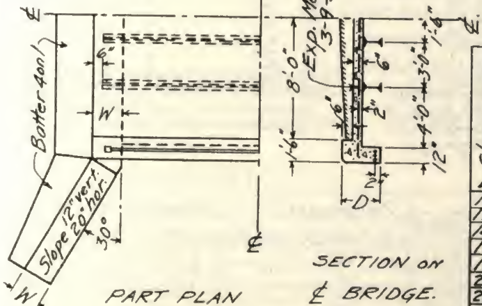
1910.



ELEVATION | SECTION ON ℄ ROADWAY.



ISOMETRIC VIEW.



PART PLAN

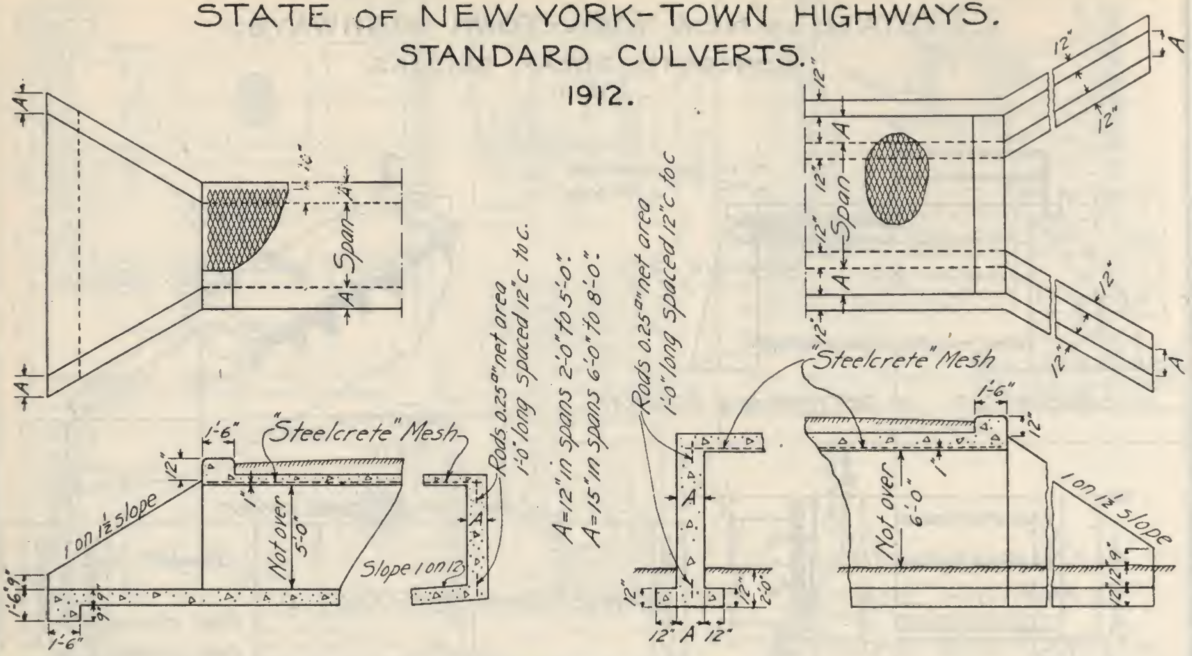
SECTION ON ℄ BRIDGE.

Concrete 1:2½:5 mixture.

Load = 10 ton road roller.

Clear Span.	Size of I-Beams	Size of Rods.	D.	Weight. Rods Lbs.	Weight. I Beams Lbs.	Expanded Metal. Sq. Ft.	CONCRETE CU. YDS. IN FLOOR ONLY.
10'	12"-31½# × 12'-0"	0.39□" × 12'-6"	2'-3"	105	1512	260	6.62
12'	" " × 14'-0"	0.56□" × 15'-0"	2'-3"	181	1764	300	7.64
14'	" " × 16'-0"	0.77□" × 17'-6"	2'-3"	287	2016	340	8.66
16'	15"-42# × 19'-0"	" × 19'-6"	2'-6"	319	3192	400	10.56
18'	" " × 21'-0"	1.00□" × 22'-0"	2'-6"	473	3528	440	11.61
20'	" " × 23'-0"	" × 24'-0"	2'-6"	515	3864	470	12.67
22'	18"-55# × 25'-0"	" × 26'-0"	2'-9"	537	5500	510	14.20
24'	" " × 27'-0"	1.56□" × 28'-7"	2'-9"	959	5940	550	15.30
26'	" " × 29'-0"	" × 30'-7"	2'-9"	1024	6380	590	16.40
28'	20"-65# × 31'-0"	" × 32'-8"	2'-11"	1094	8060	630	17.89
30'	" " × 33'-0"	" × 34'-8"	2'-11"	1163	8580	670	19.00

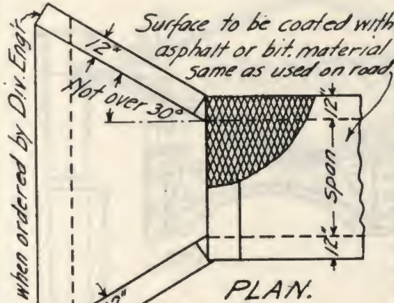
STATE OF NEW YORK–TOWN HIGHWAYS.
STANDARD CULVERTS.
1912.



Note:- Round all exposed edges to a 1½" radius.
2nd class concrete in slabs.
3rd class concrete in wing walls & abutments.
Water way to be paved when in the judgment of the County Engineer, paving is necessary.
Pile foundations to be used in light or shifting soils.

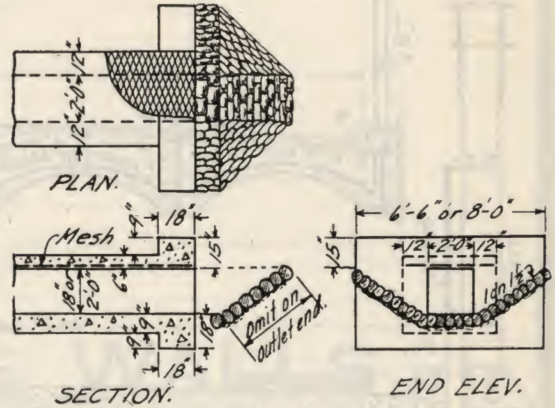
Span	Thickness of slab	"Steelcrete" Mesh Designation	"Steelcrete" Mesh wgt. per sq. ft.
2'-0"	6"	3-9-175	0.64*
3'-0"	6"	3-9-35	1.28
4'-0"	6"	3-9-35	1.28
5'-0"	8"	3-9-35	1.28
6'-0"	9"	3-6-60	2.19
7'-0"	10"	3-6-60	2.19
8'-0"	12"	3-6-60	2.19

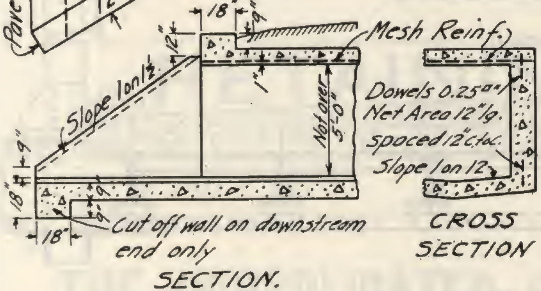
STATE OF NEW YORK
Standard Concrete Culverts.
FOR STATE AND COUNTY HIGHWAYS.
1912.



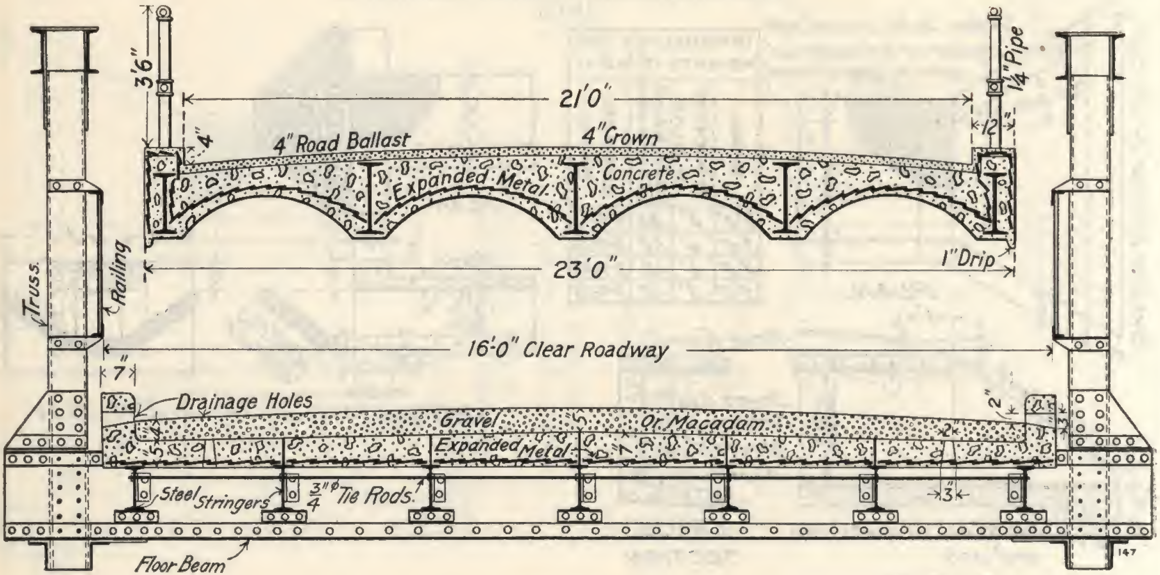
DIMENSIONS FOR HEIGHTS 18" to 5'-0"

SPAN.	THICKNESS OF SLAB.	MESH REINF. LBS. PER SQ. FT.	EXPANDED METAL.
2'-0"	6"	0.6	3-9-175
3'-0"	6"	1.2	3-9-35
4'-0"	6"	1.2	3-9-35
5'-0"	8"	1.2	3-9-35





Note:- All mesh reinforcement to be of medium steel.
All slabs and parapets to be of 2nd class concrete.
All wings, inverts and abutments to be of 3rd class concrete.
Wings on outlet end of all square culverts with concrete floors to be built parallel to the center line of the culvert.
All exposed edges to be rounded to a 1½" radius.



BRIDGE FLOORS

The style of floor shown in the lower figure has been adopted as a standard by the State of New York, as it is cheaper in the long run than plank.

Comparative Type: Little need be said of the economy of the reinforced over the non-reinforced type of retaining walls. Suffice it to say a total saving of 25 per cent. to 45 per cent. has been reached in railroad and municipal work by the adoption of the steel reinforced type. The somewhat technical features entering into the design of the reinforced type of retaining walls, coupled with the lack of standardized designs, has served to retard its universal adoption.

Reinforced Types: In standardizing the two common types of reinforced retaining walls, namely, the 'cantilever' and the 'counterfort,' this pamphlet, in the accompanying designs and data, will be found to fill a long felt want. The quantities of material also included in the tables will facilitate greatly the estimating of costs. The designs herewith submitted will be found to conform with the best standard practice. According to authorities cantilever types are more economical than the counterfort, up to a heighth of 16 to 20 feet. The quantities given will enable anyone to arrive at the most economical construction for his particular case. An allowance should be made for the increased labor on form work in the counterfort type of retaining walls.

Foundation: No wall should be built on a foundation of soil of less bearing power than three tons per square foot, and wherever possible the wall should be built on rock. If a clay foundation must be resorted to, it is very important that it be kept dry and below the frost line. When troubled with springs or accumulative surface water, provide trenches every ten feet to drain the water from the foundation. Such trenches may be one foot width and depth, and filled with coarse gravel well compacted and given sufficient slope to insure run off.

Baker's Table of safe bearing power of soils gives the following permissible loads:]

	tons per square feet,
Rock equal to best ashlar	25 to 30
Rock equal to best brick masonry	15 to 20
Rock equal to poor brick masonry	5 to 10
Clay—dry thick beds	4 to 6
Clay—Moderately dry thick beds	2 to 4
Clay—Soft	1 to 2
Gravel and coarse sand well cemented	8 to 10
Sand—Compact and well cemented	4 to 6
Sand—Clean and dry	2 to 4
Quick sand, alluvial soil, etc.	½ to 1

The Key:

There are three phases of wall failure, viz: overturning, crushing and sliding. The first two have been properly cared for in the designs shown. The third depends more or less on the nature of the soil which is taken for the foundation. A wall built on solid rock does not necessarily have to be keyed, but the surface of the rock should be roughened. In all other soils a key is absolutely necessary to keep the wall from sliding and throwing the wall out of alignment. The key is shown on all designs, Plates I, II, III, and IV. The key is that small portion of the wall which projects downward from the base at about its center.

Concrete:

Proportion 1: 2: 4.

Expansion Joints:

If it is desired to guard strongly against seepage of water through cracks which may result from temperature changes, expansion joints should be provided at intervals of thirty feet which extend from the foundation bed through the coping. Water may be prevented from seeping through these joints by forming a rectangular vertical recess in the wall as it is built up, which is filled and well rammed with plastic clay. Authorities differ on the subject of expansion joints. In many instances cases may be cited where expansion joints have been left out, and the work found perfectly satisfactory.

Sufficient steel has been allowed in the designs hereinafter submitted to take care of temperature stresses according to theoretical and common practice. It should be remembered that there is a big distinction between surface hair cracks and deep cracks permitting seepage.

Water-Proofing:

A concrete mixture so proportioned as to give the maximum density has been demonstrated to be satisfactorily waterproof. If it is deemed advisable, however, any good waterproofing compound may be added.

Surface Finish:

Many methods of finishing concrete surfaces are in vogue. Some are as follows:

- Cement washing or grouting
- Rubbing up
- Tooling
- Sand Blasting
- Plastering

It has been found more satisfactory and economical to decide which surface finish is desired before the work is started so that the surface may be treated immediately after the forms are taken down and while the concrete is green. On plastered surfaces, the rough or unfinished side of the board should be next to the wall. This gives a rough surface and aids the plaster in adhering to the wall. Boards of unequal thickness should be avoided in forms in which a surface finish is desired.

Back Fill:

All coarse material, such as broken stone or unused gravel, should be placed in back of wall. A volume of at least one-half cubic yards of such material should be placed at the inside end of the drains, so that they will not become stopped up with earth. Space drains of three inch diameter five feet on centers, and place them at such a height from the surface of the ground that a free discharge of the water back of the wall will be allowed. Supplying the wall with drains aids waterproofing and serves as a precautionary method of eliminating the hydrostatic head which may form back of the wall.

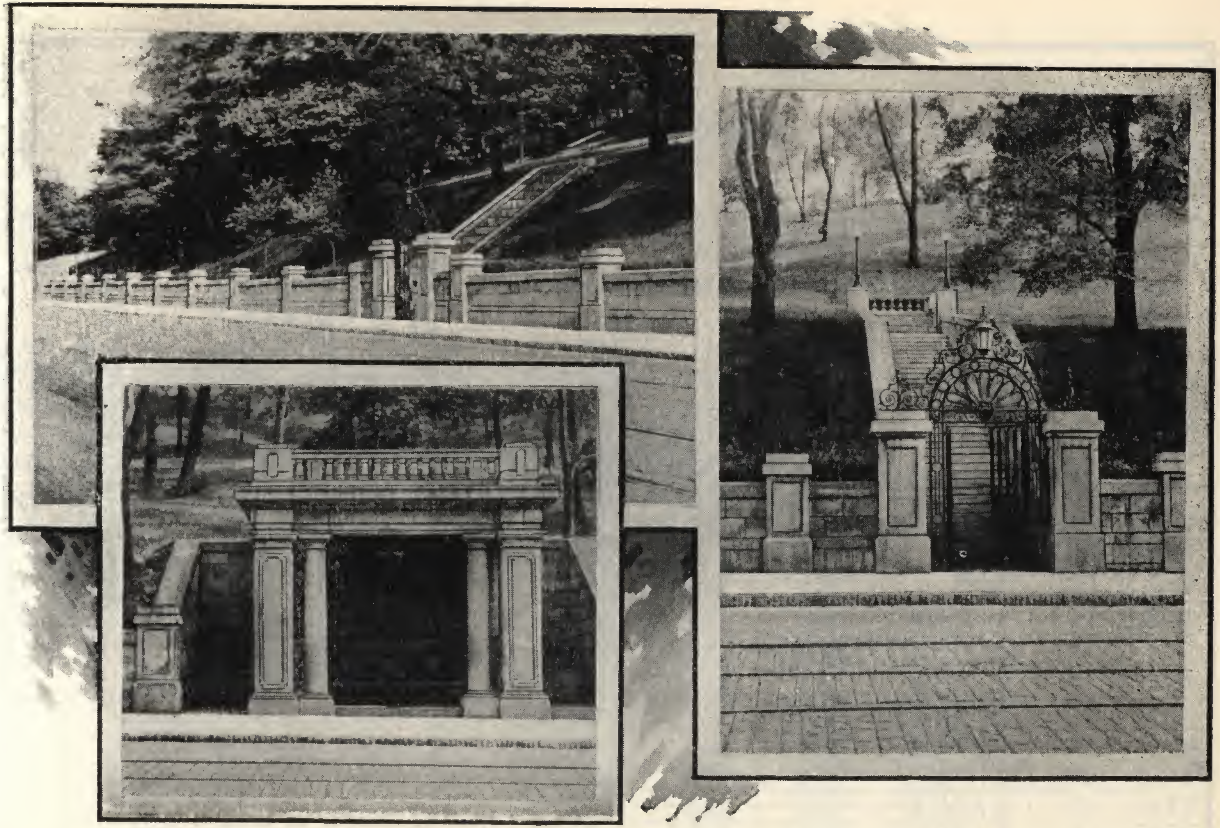
The following notes are to be used in connection with Plates I, II, III, and IV.

Spacing of Horizontal Tie Rods:

The spacing shown on line 'M' Plate IV is given for a wall of 25 foot height, (H=25′-0″). For any wall of less height the spacing applies as given, to be read from the top, omitting whatever rods may not be included. Example: The spacing of these horizontal rods for an 18 ft. wall (H=18′-0″) would be as follows, reading downward from the top:—2′0″, 2′0″, 1′6″, 1′3″. Three spaces at 1′0″, seven spaces at 9″ and two spaces at 6″, the remaining rods of the sketch being omitted. The sum of the above spaces equal 16′0″. The bottom slab is 1′-10″ according to the tables; therefore, 16′0″ plus 1′10″ equals 17′10″ or the last horizontal tie rod is 2″ above the bottom slab of the wall.

Note on "Steelcrete" for Counterfort Type:

Sheets extend continuously across the front face of the counterfort type as indicated in section X Y of Plate IV, Sheets 6′0″ total length of the same size as in front to be placed on back of face wall at the counterforts. This is also indicated in the same section. The direction of the diamonds in all the mesh in the face wall is given in the rear elevation of Plate IV. All sheets should be lapped the length of one diamond (8″) on the ends to insure continuity, and the width of one diamond (3″) on the sides. Wherever two or more sheets are required a spacing of one inch should be allowed between sheets to insure a good bond in the concrete.

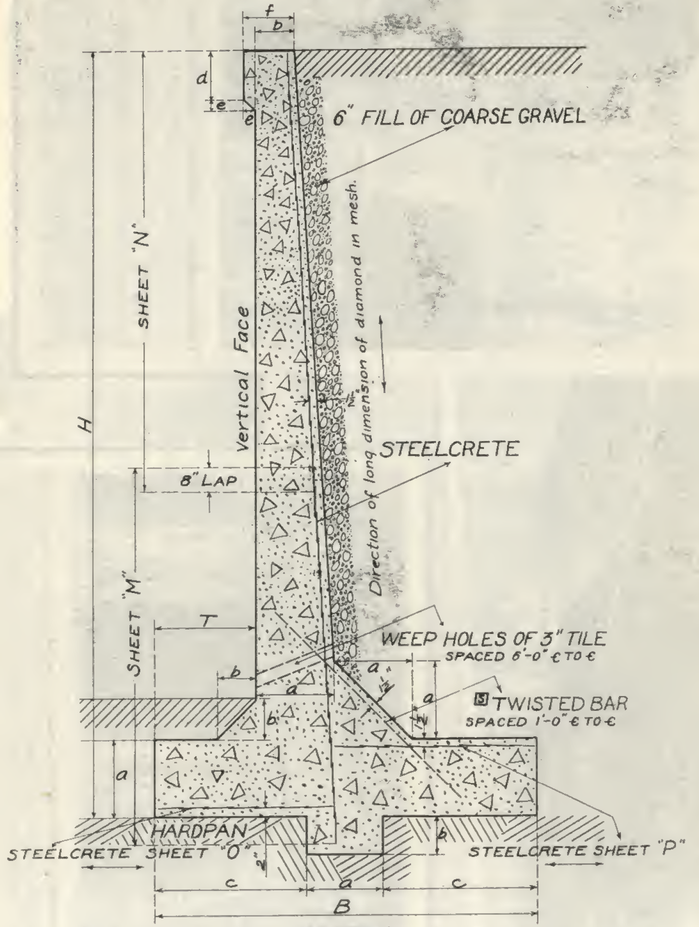


Famous Howe Springs fronting the residence of M. L. Benedum, Fifth and Highland Avenues, Pittsburgh, Pa. Retaining Wall reinforced with "Steelcrete" Mesh throughout. Surface finish imitation cut stone. W. H. Van Tine, landscape architect and designer.

RETAINING WALL

CANTILEVER TYPE

LEVEL FILL



SECTION

QUANTITIES PER LINEAR FOOT OF WALL
GIVEN IN TABLE

PLATE NO. I.

RETAINING WALL

CANTILEVER TYPE

LEVEL FILL

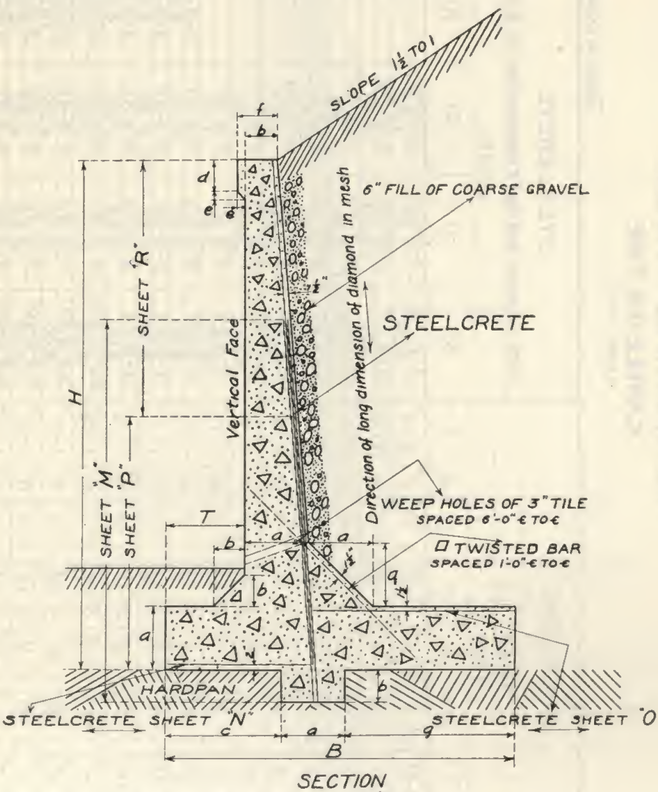
Table in connection with PLATE No. I

DIMENSIONS									STEELCRETE Size of mesh and Sq.Ft. required per lin. ft of Wall				Size of Bars	QUANTITIES per Lin. Ft. of Wall.	
Height									sheets						
	Base														
H	B	T	a	b	c	d	e	f	M	O	P	N	1 Ft. ¢ to ¢	Concrete Cu. Yds.	Bars Lbs.
6'	3'-0"	0'-10"	0'-7"	0'-6"	1'-2½"	1'-0"	3"	0'-9"	3-9-15 6.00	3-13-075 1.33	3-13-075 1.33		¼"	0.20	0.53
7'	3'-6"	0'-11"	0'-8½"	0'-6"	1'-4¾"	1'-0"	3"	0'-9"	3-9-15 8.00	3-13-075 2.00	3-13-075 1.33		⅜	0.26	1.44
8'	4'-0"	1'-1"	0'-9½"	0'-6"	1'-7¼"	1'-0"	3"	0'-9"	3-9-20 8.00	3-13-10 2.00	3-13-10 2.00		⅜	0.32	1.61
9'	4'-6"	1'-2"	0'-11"	0'-6"	1'-9½"	1'-0"	3"	0'-9"	3-9-20 10.00	3-13-10 2.33	3-13-10 2.00		⅜	0.41	1.86
10'	5'-0"	1'-4"	1'-0"	0'-6"	2'-0"	1'-0"	3"	0'-9"	3-9-25 10.00	3-13-125 2.66	3-13-125 2.33		⅜	0.48	2.03
11'	5'-6"	1'-6"	1'-1"	0'-6½"	2'-2½"	1'-0"	3"	0'-9½"	3-9-30 12.00	3-9-15 2.66	3-9-15 2.66		½	0.57	3.89
12'	6'-0"	1'-7"	1'-2½"	0'-7"	2'-4¾"	1'-6"	4½"	0'-11½"	3-9-35 12.00	3-9-20 3.00	3-9-25 3.00		½	0.67	4.36
13'	6'-6"	1'-9"	1'-3½"	0'-8"	2'-7¼"	1'-6"	4½"	1'-0½"	3-6-45 8.00	3-9-20 3.33	3-9-25 3.00	3-9-20 6.00	½	0.80	4.67
14'	7'-0"	1'-11"	1'-5"	0'-8½"	2'-9½"	1'-6"	4½"	1'-1"	3-6-50 8.00	3-9-25 3.33	3-9-35 3.33	3-9-20 8.00	½	0.95	5.11
15'	7'-6"	2'-0"	1'-6"	0'-9"	3'-0"	1'-6"	4½"	1'-1½"	3-6-55 8.00	3-9-30 3.66	3-9-35 3.66	3-9-20 8.00	⅝	1.07	8.46
16'	8'-0"	2'-2"	1'-7"	0'-9½"	3'-2½"	2'-0"	6"	1'-3½"	2(3-9-35) 16.00	3-9-35 4.00	3-6-40 4.00	3-9-25 10.00	⅝	1.20	8.93
17'	8'-6"	2'-3"	1'-8½"	0'-10"	3'-4¾"	2'-0"	6"	1'-4"	2(3-9-35) 16.00	3-9-35 4.00	3-6-45 4.00	3-9-25 10.00	⅝	1.38	9.64
18'	9'-0"	2'-5"	1'-9½"	0'-11"	3'-7¼"	2'-0"	6"	1'-5"	2(3-6-40) 16.00	3-6-40 4.33	3-6-50 4.33	3-9-30 12.00	⅝	1.55	10.10
19'	9'-6"	2'-7"	1'-11"	0'-11½"	3'-9½"	2'-0"	6"	1'-5½"	2(3-6-45) 16.00	3-6-40 4.66	3-6-55 4.66	3-9-35 12.00	¾	1.74	15.57
20'	10'-0"	2'-8"	2'-0"	1'-0"	4'-0"	2'-0"	6"	1'-6"	2(3-6-50) 24.00	3-6-45 5.00	3-6-60 5.00	3-9-35 10.00	¾	1.91	16.24

RETAINING WALL

CANTILEVER TYPE

SLOPING FILL



SECTION

QUANTITIES PER LINEAR FOOT OF WALL
GIVEN IN TABLE

PLATE NO. II

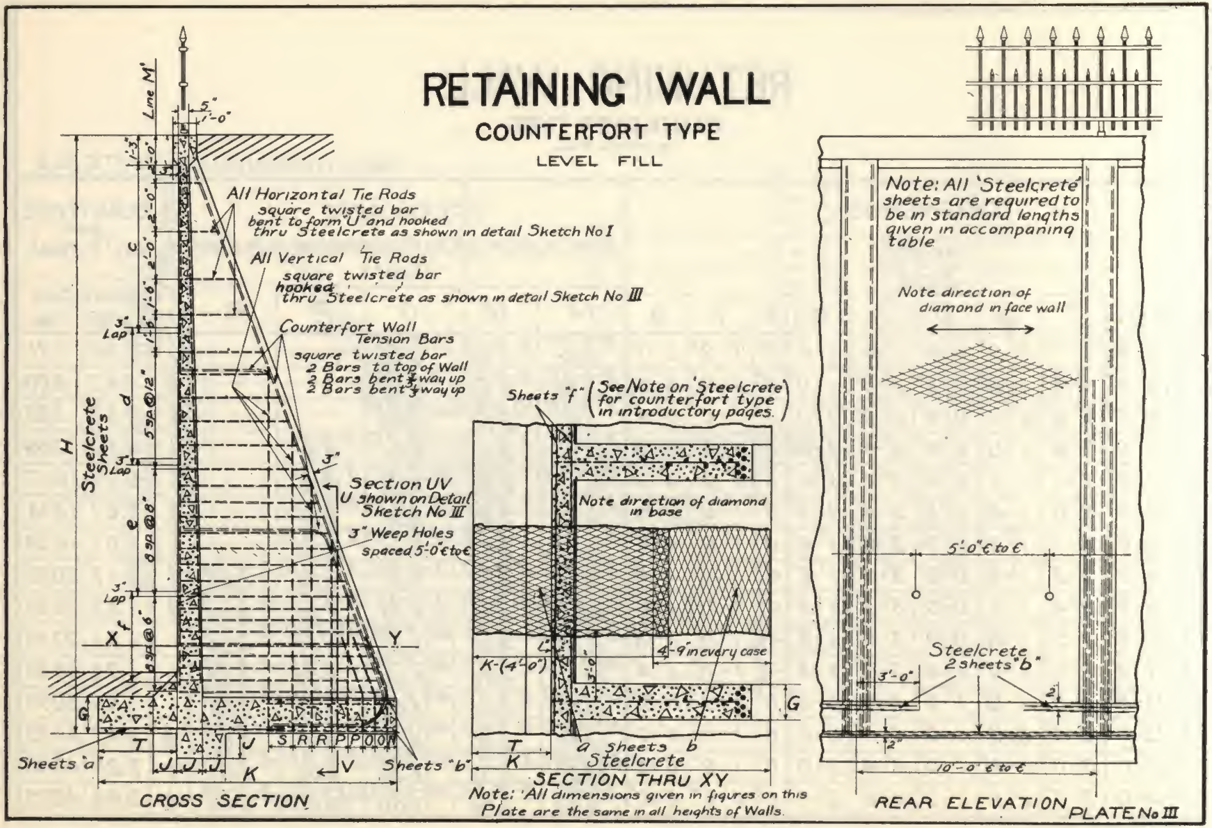
RETAINING WALL

CANTILEVER TYPE

SLOPING FILL

Table in connection with PLATE No. II

DIMENSIONS										STEELCRETE Size of mesh and Sq. Ft. required per lin. ft of Wall					Size of Bars	QUANTITIES per Lin. Ft of Wall	
	Height									sheets							
		Base															
H	B	T	a	b	c	d	e	f	g	M	N	O	P	R	1 Ft. ℄ to ℄	Concrete Cu. Yds.	Bars Lbs.
6'	5'-6"	1'-7"	0'-9"	0'-9"	1'-10"	1'-0"	3"	1'-0"	2'-11"	3-9-35 6.00	3-9-20 2.33	3-9-30 3.00			1/2"	0.34	2.71
7'	6'-0"	1'-8"	0'-10½"	0'-9"	2'-0"	1'-0"	3"	1'-0"	3'-1½"	3-9-35 8.00	3-9-20 2.66	3-9-30 3.33			9/16	0.43	4.00
8'	6'-6"	1'-9"	1'-0"	0'-9"	2'-2"	1'-0"	3"	1'-0"	3'-4"	3-6-50 8.00	3-9-20 2.66	3-9-35 4.00			5/8	0.52	5.55
9'	7'-0"	1'-10"	1'-1½"	0'-9"	2'-4"	1'-0"	3"	1'-0"	3'-6½"	3-6-40 12.00	3-9-20 3.00	3-9-35 4.00	3-6-40 8.00		11/16	0.62	7.69
10'	7'-6"	1'-11"	1'-3"	0'-9"	2'-6"	1'-0"	3"	1'-0"	3'-9"	2(3-6-40) 16.00	3-9-20 3.33	3-6-45 4.00	3-9-30 10.00		3/4	0.74	10.17
11'	8'-0"	2'-0"	1'-4½"	0'-9"	2'-8"	1'-0"	3"	1'-0"	3'-11½"	3-6-40 12.00	3-9-25 3.33	3-6-50 4.33	3-6-60 8.00		13/16	0.87	13.13
12'	8'-6"	2'-1"	1'-6"	0'-9"	2'-10"	1'-0"	3"	1'-0"	4'-2"	3-6-60 8.00	3-9-25 3.33	3-6-55 4.66	3-6-60 12.00		7/8	1.01	16.59
13'	9'-0"	2'-3"	1'-7½"	0'-10"	3'-0"	1'-6"	4½"	1'-2½"	4'-4½"	3-6-60 12.00	3-9-25 3.66	3-6-60 5.00	3-6-60 8.00	3-9-35 6.00	15/16	1.17	20.65
14'	9'-8"	2'-4"	1'-9"	0'-10"	3'-3"	1'-6"	4½"	1'-2½"	4'-8"	2(3-6-55) 24.00	3-9-30 4.00	3-6-60 5.33	3-6-55 8.00	3-9-15 4.00	15/16	1.33	22.25
15'	10'-4"	2'-5"	1'-10½"	0'-10"	3'-5"	1'-6"	4½"	1'-2½"	5'-0½"	3-6-50 12.00	3-9-35 4.00	2(3-6-40) 12.00	2(3-6-60) 16.00	3-9-15 4.00	1	1.51	27.10
16'	11'-0"	2'-6"	2'-0"	1'-0"	3'-8"	1'-6"	4½"	1'-2½"	5'-4"	2(3-6-60) 24.00	3-9-35 4.66	2(3-6-45) 12.00	3-6-60 8.00	3-9-25 6.00	1	1.78	28.90
17'	11'-8"	2'-8"	2'-1½"	1'-0"	3'-10"	2'-0"	6"	1'-6"	5'-8½"	2(3-6-60) 24.00	3-9-35 5.00	2(3-6-50) 12.00	3-6-60 8.00	3-9-35 6.00	1	1.96	30.70
18'	12'-4"	2'-10"	2'-3"	1'-0"	4'-1"	2'-0"	6"	1'-6"	6'-0"	2(3-6-60) 24.00	3-6-45 5.00	2(3-6-60) 16.00	3-6-60 8.00	3-9-35 8.00	1⅛	2.17	41.65
19'	13'-0"	3'-0"	2'-4½"	1'-0"	4'-4"	2'-0"	6"	1'-6"	6'-3½"	2(3-6-60) 24.00	3-6-50 5.33	2(3-6-60) 16.00	3-6-60 8.00	3-6-50 8.00	1⅛	2.29	43.50
20'	14'-0"	3'-3"	2'-6"	1'-0"	4'-8"	2'-0"	6"	1'-6"	6'-10"	3-6-60 8.00	3-6-55 6.00	2(3-6-60) 16.00	2(3-6-60) 24.00	3-6-60 8.00	1⅛	2.66	45.75



RETAINING WALL
COUNTERFORT TYPE
LEVEL FILL
All Horizontal Tie Rods square twisted bar bent to form "U" and hooked thru Steelcrete as shown in detail Sketch No I
All Vertical Tie Rods square twisted bar hooked thru Steelcrete as shown in detail Sketch No III
Counterfort Wall Tension Bars square twisted bar 2 Bars to top of Wall 2 Bars bent ⅔ way up 2 Bars bent ⅓ way up
Section UV U shown on Detail Sketch No III
3" Weep Holes spaced 5'-0" ℄ to ℄
Steelcrete Sheets
Sheets "a"
Sheets "b"
CROSS SECTION
Sheets "f" (See Note on 'Steelcrete' for counterfort type in introductory pages.)
Note direction of diamond in base
4'-9" in every case
K-(4'-0")
a Sheets b Steelcrete
SECTION THRU XY
Note: All dimensions given in figures on this Plate are the same in all heights of Walls.
Note: All 'Steelcrete' sheets are required to be in standard lengths given in accompaning table
Note direction of diamond in face wall
5'-0" ℄ to ℄
Steelcrete 2 sheets "b"
10'-0" ℄ to ℄
REAR ELEVATION
PLATE No III

RETAINING WALL

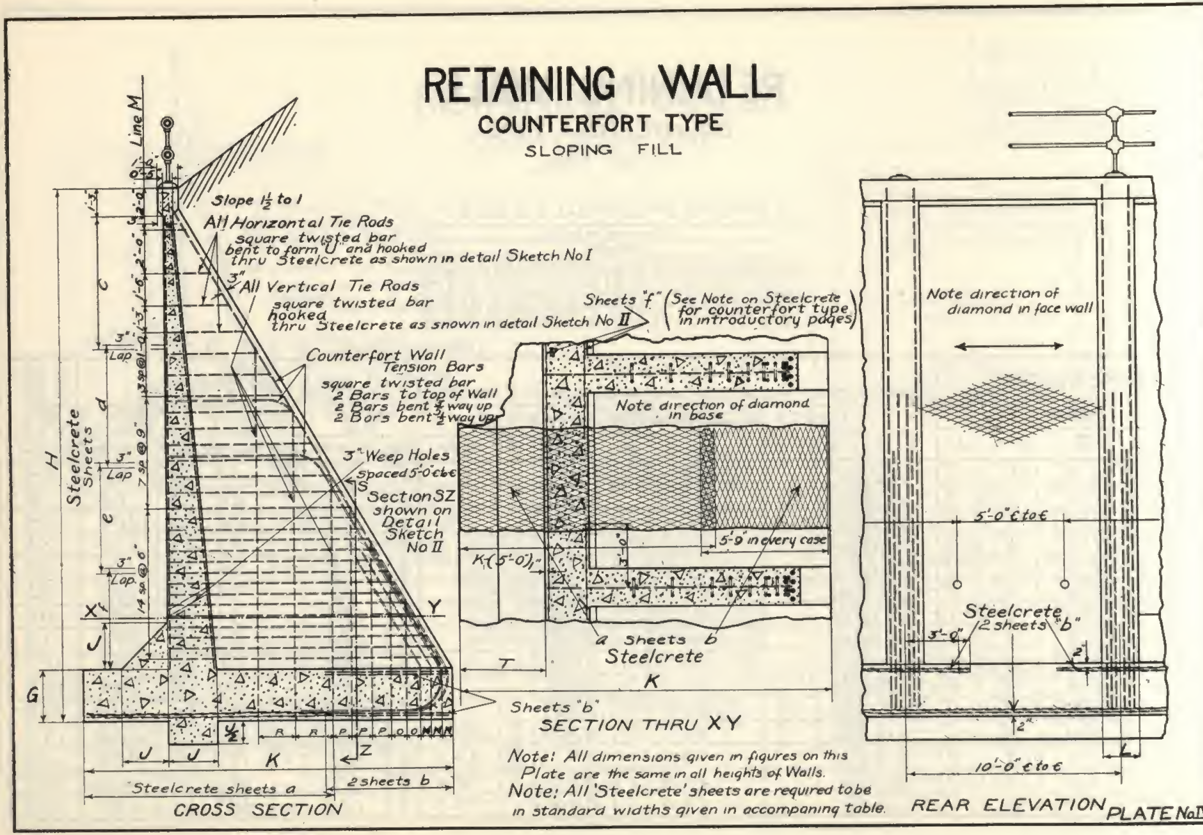
COUNTERFORT TYPE

LEVEL FILL

SPACING OF VERTICAL TIE RODS															
	Spacing in inches														
	Height														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
N	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
O	3	3	3	3	4	4	4	4	4	6	6	6	6	6	6
P	4	4	4	4	6	6	6	6	6	8	8	8	8	8	8
R	5	5	5	5	7	7	7	7	7	10	10	10	10	10	10
S	6	6	6	6	9	9	9	9	9	12	12	12	12	12	12

Tables in connection with PLATE No. III

DIMENSIONS					STEELCRETE Size of mesh and Quantities required per 10'-0" Section									BARS Weight per 10'-0" Section Cold Twisted Square Steel						Concrete per 10'-0" Section Cubic Yards
	HEIGHT				SHEETS AS DESIGNATED ON PLATE III									Vertical Ties		Horizontal Ties		Tension Bars		
H	K	T	G	J	a	b	c	d	Sq. Ft.	e	Sq. Ft.	f	Sq. Ft.	Size	Wt. in lbs.	Size	Wt. in lbs.	Size	Wt. in lbs.	
11'	5'-6"	1'-6"	1'-0"	0'-7"	3-9-20 15.8 Sq. Ft.	158 SQ. FT.	116.7 SQ. FT.	3-6-50	33.3					$\frac{1}{2}$"	33	$\frac{1}{2}$"	18	$\frac{1}{2}$"	58	5.4
12'	6'-0"	1'-7"	1'-0"	0'-7"	3-9-25 21.0 Sq. Ft.				50.0					$\frac{1}{2}$	33	"	22	$\frac{1}{2}$	62	5.8
13'	6'-6"	1'-9"	1'-0"	0'-7"	3-9-30 26.3 Sq. Ft.				66.7					$\frac{1}{2}$	33	"	28	$\frac{5}{8}$	104	6.4
14'	7'-0"	1'-11"	1'-0"	0'-10"	3-9-35 31.5 Sq. Ft.				83.3					$\frac{1}{2}$	33	"	33	$\frac{5}{8}$	110	7.6
15'	7'-6"	2'-0"	1'-2"	0'-10"	3-9-35 36.8 Sq. Ft.				96.0					$\frac{1}{2}$	43	"	34	$\frac{11}{16}$	137	8.8
16'	8'-0"	2'-2"	1'-2"	0'-10"	3-6-45 42.0 Sq. Ft.				96.0	3-6-55	22.2			$\frac{9}{16}$	55	"	44	$\frac{11}{16}$	145	9.5
17'	8'-6"	2'-3"	1'-2"	0'-11"	3-6-55 47.3 Sq. Ft.				96.0		38.8			$\frac{9}{16}$	55	"	51	$\frac{3}{4}$	182	10.6
18'	9'-0"	2'-5"	1'-2"	0'-11"	3-6-60 52.5 Sq. Ft.				96.0		55.5			$\frac{5}{8}$	68	"	63	$\frac{3}{4}$	192	11.2
19'	9'-6"	2'-7"	1'-4"	0'-11"	3-6-60 57.8 Sq. Ft.				96.0		69.5			$\frac{5}{8}$	68	"	7.0	$\frac{3}{4}$	203	12.7
20'	10'-0"	2'-8"	1'-4"	1'-0"	2(3-6-40) 126.0 Sq. Ft.	3-6-60	3-6-40		96.0		86.3			$\frac{5}{8}$	89	"	83	$\frac{13}{16}$	249	14.0
21'	10'-6"	2'-10"	1'-4"	1'-0"	2(3-6-40) 136.5 Sq. Ft.				96.0		87.5			$\frac{5}{8}$	89	"	89	$\frac{7}{8}$	302	14.8
22'	11'-0"	2'-11"	1'-4"	1'-0"	2(3-6-40) 147.0 Sq. Ft.				96.0		87.5	3-6-60	27.8	$\frac{11}{16}$	108	"	103	$\frac{15}{16}$	362	15.7
23'	11'-6"	3'-1"	1'-6"	1'-0"	2(3-6-40) 157.5 Sq. Ft.				96.0		87.5		41.7	$\frac{11}{16}$	108	"	117	1	425	17.9
24'	12'-0"	3'-2"	1'-6"	1'-0"	2(3-6-45) 168.0 Sq. Ft.				96.0		87.5		58.4	$\frac{3}{4}$	128	"	131	1	442	18.9
25	12'-6"	3'-4"	1'-6"	1'-0"	2(3-6-50) 178.5 Sq. Ft.				96.0		87.5		79.3	$\frac{3}{4}$	128	"	137	1	460	19.9


RETAINING WALL
COUNTERFORT TYPE
SLOPING FILL
Line M
Slope 1½ to 1
All Horizontal Tie Rods
square twisted bar
bent to form "U" and hooked
thru Steelcrete as shown in detail Sketch No I
All Vertical Tie Rods
square twisted bar
hooked
thru Steelcrete as shown in detail Sketch No II
Counterfort Wall
Tension Bars
square twisted bar
2 Bars to top of Wall
2 Bars bent ¼ way up
2 Bars bent ½ way up
3" Weep Holes
spaced 5'-0" c to c
Section SZ
shown on
Detail
Sketch
No II
Steelcrete
Sheets
H
G
J
K
X
Y
Z
Lap
Steelcrete sheets a
2 sheets b
CROSS SECTION
Sheets "f" (See Note on Steelcrete for counterfort type in introductory pages)
Note direction of diamond in base
5'-9" in every case
K-(5'-0")
T
a Sheets b
Steelcrete
Sheets "b"
SECTION THRU XY
Note: All dimensions given in figures on this Plate are the same in all heights of Walls.
Note: All 'Steelcrete' sheets are required to be in standard widths given in accompaning table.
Note direction of diamond in face wall
5'-0" c to c
Steelcrete
2 sheets "b"
3'-0"
10'-0" c to c
L
REAR ELEVATION
PLATE No IV

RETAINING WALL

COUNTERFORT TYPE

SLOPING FILL

STANDARD SIZES OF SQUARE BAR		
Size	Area	Wt/lin Ft.
1/2	.2500□"	.850 #
9/16	.3164	1.076
5/8	.3906	1.328
11/16	.4727	1.607
3/4	.5625	1.913
13/16	.6602	2.245
7/8	.7656	2.603
15/16	.8789	2.988
1	1.0000	3.400
1 1/8	1.2656	4.303
1 1/4	1.5625	5.312
1 3/8	1.8906	6.428
1 1/2	2.2500	7.650

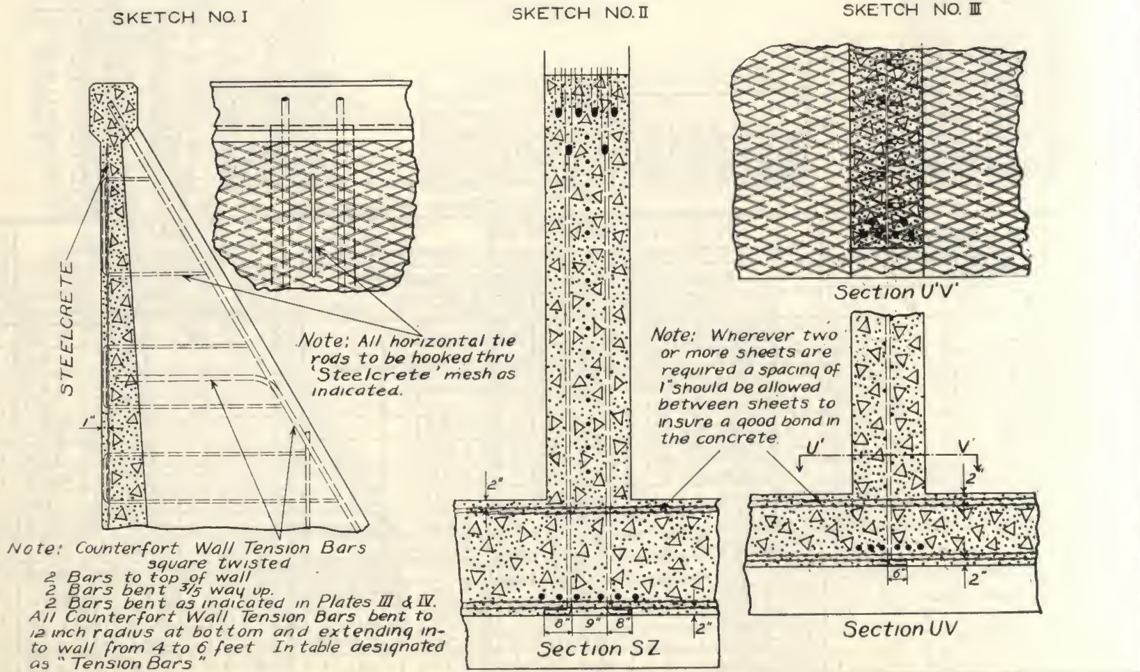
SPACING OF VERTICAL TIE RODS															
	Spacing in inches														
	Height														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
N	3	3	3	3	3	4	4	4	4	4	6	6	6	6	6
O	5	5	5	5	5	6	6	6	6	6	8	8	8	8	8
P	6	6	6	6	6	8	8	8	8	8	11	11	11	11	11
R	11	11	11	11	11	15	15	15	15	15	21	21	21	21	21

STANDARD SIZES STEELCRETE				
Size	Area/Ft W	Wt/Sq Ft	Width	Length
3-13-075	.075 sq in	.27 lbs.	6'-0"	Standard Lengths 8'-0" and 12'-0"
3-13-10	.10 "	.37 "	6'-9"	
3-13-125	.125 "	.46 "	5'-3"	
3-13-15	.15 "	.55 "	7'-0"	
3-9-20	.20 "	.73 "	5'-3"	
3-9-25	.25 "	.92 "	4'-0"	
3-9-30	.30 "	1.10 "	7'-0"	
3-9-35	.35 "	1.28 "	6'-0"	
3-6-40	.40 "	1.46 "	7'-0"	
3-6-45	.45 "	1.65 "	6'-3"	
3-6-50	.50 "	1.83 "	5'-9"	
3-6-55	.55 "	2.01 "	5'-3"	
3-6-60	.60 "	2.19 "	4'-9"	

Tables in connection with PLATE No. IV

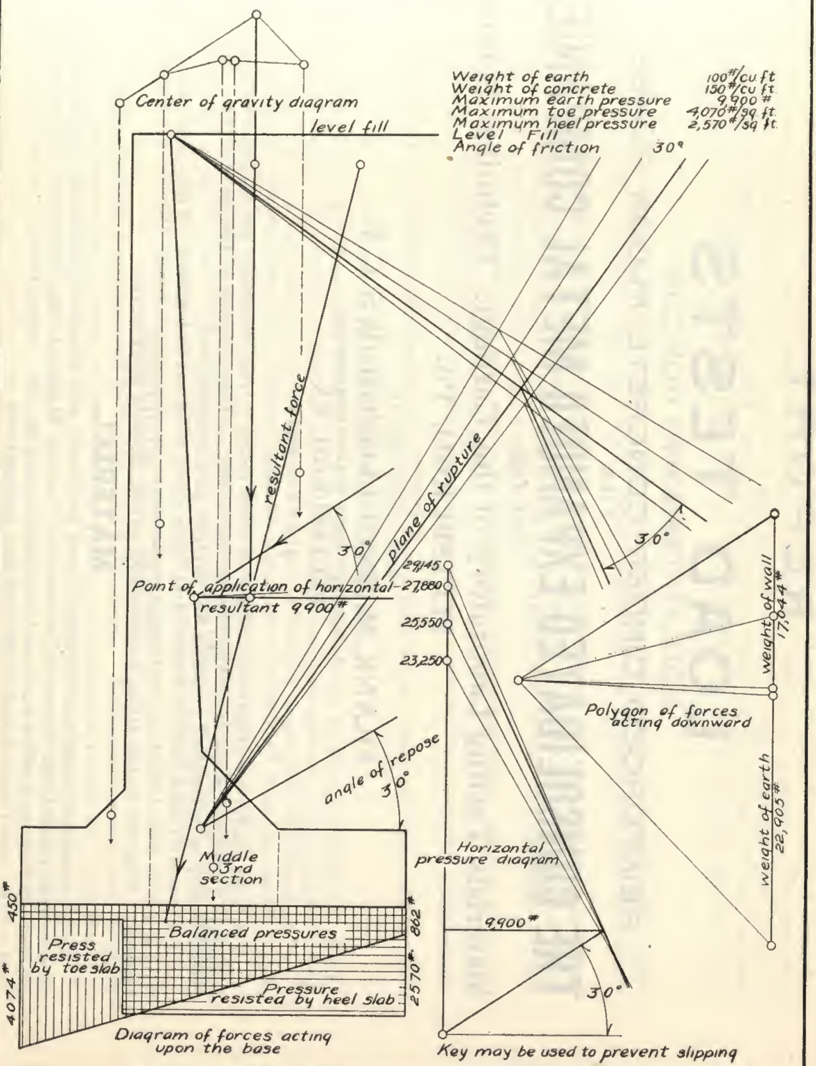
DIMENSIONS						STEELCRETE Size of mesh and Quantities required per 10'-0" Section									BARS Weight per 10'-0" Section Cold Twisted Square Steel						Concrete per 10'-0" Section Cubic Yards
	HEIGHT					SHEETS AS DESIGNATED ON PLATE IV									Vertical Ties		Horizontal Ties		Tension Bars		
H	K	T	G	J	L	a	b	c	d	Sq Ft.	e	Sq Ft.	f	Sq Ft.	Size	Wt. in lbs	Size	Wt. in lbs	Size	Wt. in lbs	
11'	8'-0"	2'-0"	1'-3"	1'-1"	1'-3"	3-9-25 31.50 Sq Ft				41.65					1/2"	117	5/8"	31	11/16"	142	8.2
12'	8'-6"	2'-1"	1'-4"	1'-2"	1'-4"	3-9-30 36.75 Sq Ft				56.80					1/2	117	"	47	3/4	180	9.4
13'	9'-0"	2'-3"	1'-5"	1'-3"	1'-5"	3-9-30 42.00 Sq Ft				71.60					1/2	117	"	56	13/16	229	11.1
14'	9'-8"	2'-4"	1'-6"	1'-4"	1'-6"	3-9-35 49.00 Sq Ft				87.50					1/2	117	"	65	7/8	287	12.3
15'	10'-4"	2'-5"	1'-7"	1'-5"	1'-7"	3-6-40 56.00 Sq Ft	191.7 SQ. FT.	104.2 SQ. FT.		96.00		11.10			1/2	117	"	76	15/16	350	14.0
16'	11'-0"	2'-6"	1'-8"	1'-6"	1'-8"	3-6-45 63.00 Sq Ft				96.00		26.35			9/16	180	"	87	15/16	374	15.9
17'	11'-8"	2'-8"	1'-9"	1'-7"	1'-9"	3-6-45 70.00 Sq Ft				96.00		41.70			9/16	180	"	110	1	449	18.2
18'	12'-4"	2'-10"	1'-10"	1'-8"	1'-9"	3-6-55 77.00 Sq Ft			3-6-50	96.00		57.00			5/8	222	"	134	1 1/8	603	19.7
19'	13'-0"	3'-0"	1'-11"	1'-9"	1'-9"	3-6-60 84.00 Sq Ft				96.00		72.22			5/8	222	"	160	1 1/8	637	21.8
20'	13'-8"	3'-2"	2'-0"	1'-10"	1'-9"	2(3-6-40) 182.00 Sq Ft				96.00	3-6-55	87.50			5/8	222	"	173	1 1/4	823	23.9
21'	14'-4"	3'-4"	2'-1"	1'-11"	1'-9"	2(3-6-40) 196.00 Sq Ft	3-6-50	3-6-45		96.00		87.50		19.50	5/8	284	"	202	1 1/4	866	26.0
22'	15'-0"	3'-6"	2'-2"	2'-0"	1'-9"	2(3-6-40) 210.00 Sq Ft				96.00		87.50		34.70	11/16	344	"	231	1 3/8	1093	28.4
23'	15'-8"	3'-8"	2'-3"	2'-1"	1'-9"	2(3-6-45) 224.50 Sq Ft				96.00		87.50	3-6-60	50.00	11/16	344	"	263	1 3/8	1150	30.8
24'	16'-6"	3'-10"	2'-4"	2'-2"	1'-9"	2(3-6-50) 241.50 Sq Ft				96.00		87.50		65.40	3/4	410	"	296	1 1/2	1424	33.5
25'	17'-4"	4'-0"	2'-5"	2'-3"	1'-9"	2(3-6-55) 259.00 Sq Ft				96.00		87.50		80.70	3/4	410	"	315	1 1/2	1485	368

RETAINING WALL
COUNTERFORT TYPE
DETAILS



RETAINING WALL

GRAPHICAL SOLUTION



REPORT
OF
LOAD TESTS
MADE ON
REINFORCED CINDER CONCRETE FLOOR SLABS
FOR
THE CONSOLIDATED EXPANDED METAL COMPANIES
AT THE
Materials Testing Laboratory of the Carnegie Technical Schools
PITTSBURGH, PA.

TESTS CONDUCTED BY
FRANK M. McCULLOUGH, B. S. C. E.
Assistant Professor in Civil Engineering
PITTSBURGH, PA.
JULY 22, 1911.

Tests on cinder concrete floor arches or slabs made in the Materials Testing Laboratory of the Carnegie Technical Schools during the spring of 1911. The purpose of the tests was to determine the efficiency of expanded metal in flat arch or slab construction.

Tests were made on four arches and three sizes of expanded metal. The slabs were loaded with pig iron and deflection readings were taken at increments of about 150 lbs. per sq. ft. in the loading. The age of the slabs when tested varied from 54 to 61 days.

MATERIAL.

Lehigh cement, local sand dredged from the river, and screened anthracite cinders were used. The cement passed the American Society for Testing Materials specifications. The weight per cu. ft. of the damp cinders and sand was 48 lbs. and 82 lbs. respectively; the voids of the dry cinders and sand were equal to 59% and 44%, respectively.

After making a series of volumetric tests of the materials it was decided to use a 1:2½:4½ concrete instead of a 1:2:5, the proportions being based on dry sand and cinders. The concrete was thoroughly mixed by machine and was of a wet consistency. During the pouring of the slabs samples of the concrete were taken which, when tested in the form of cylinders, 6″ in diameter and 18″ high, gave crushing strengths of 631 and 785 lbs. per square inch at 33 days and 56 days, respectively.

METHOD OF CONSTRUCTION.

A foundation of 1:2:4 gravel concrete, 12 in. thick and about 3 ft. high, was first built. Upon this foundation were imbedded bearing plates which supported the I-beams of the flat arches or slabs.

Each of the arches was of the flat type and was carried by two 12 in. 31½ lb. I-beams spaced 6 ft. on centers. These I-beams were connected by two ¾ in. steel rods with nuts set so that there was little initial tension in the rods. The length of the arches was 6 ft., the thickness at the center and haunches was 4 in. and 15 in., respectively.

The arches were all reinforced with sheets of "Steelcrete" Expanded Metal; arches O and Q with 3-13-075, N with 3-9-175, and P with 3-9-15.

The cross-sections of the sheets of metal used in the arches checked these values within commercial limits.

The details of the arches and the position of the reinforcement are shown in Fig. 40.

METHOD OF TESTING.

The pig iron was piled in three separate tiers, each parallel to the I-beams in order to reduce the arching effect to a minimum. Deflections were obtained at seven points, these points being located at the center of the slab and at the center and ends of each I-beam carrying the slab.

At these points holes were left in the concrete in which were inbedded slender wooden rods carrying scales at the top. By means of a Y level these scales were read to $\frac{1}{64}$ of an inch for increments of 150 lbs. per sq. ft. in the loading, this unit load being based on the total area of the slab which was 36 sq. ft. In order to detect any change in the height of instrument, level readings were frequently taken on a permanent bench mark entirely separate from the slabs.

RESULTS OF TESTS.

The detailed results are tabulated in Tables 1 to 4, inclusive. Deflections are given in 64ths of an inch; negative values indicate a downward movement and positive values an upward movement of the slab. Rods. No. 1, No. 3, No. 5 and No. 7 were located at the ends of the 12 in. I-beams carrying the slabs, rods No. 2 and No. 6 at the centers of these I-beams, and rod No. 4 at the center of the slab, (See Fig. 40). The missing deflections are due to the fact that it was impossible to read all of the rods after the pig iron had reached a height of about 6 ft.

DISCUSSION OF RESULTS.

The arches were built in order to study their behavior under a total load of 54000 lbs. or a unit load of 1500 lbs. per sq. ft. and all of the arches were in excellent condition under this test load. At this load the deflection of the center of the slab below the center of the I-beams varied from $\frac{18}{64}$ in. for slab N to $\frac{20}{64}$ in. for slabs Q and P. When this maximum load was allowed to remain for five days on slab O, which had the lightest reinforcement, the increase in deflection was only $\frac{1}{64}$ in. When the slabs were fully loaded tension cracks were seen in the concrete near their center lines and above the I-beams at the haunches, these latter cracks being much smaller, but in none of the arches were any of the cracks serious.

After the full load of 1500 lbs. per sq. ft. had been placed on slab P it was decided to continue the loading to failure. Under a load of 2230 lbs. per sq. ft. the slab failed but this was apparently caused by the falling and consequent impact effect of the piles of pig iron which were about 12 ft. high and quite unstable. The rate of increase in the deflection readings did not indicate approaching failure nor did the fracture show an initial failure of the slab.

The maximum load carried by the slab indicated that considerable arch action was developed and that the slabs should not be considered as fixed beams, for, assuming the slab to be a fixed beam, the maximum computed stress in the steel for a load of 1500 lbs. per sq. ft. was about three times as great as the ultimate strength of the steel as determined in a tension test. It was also observed that the ¾ in. rods connecting the 12 in. I-beams which had little initial tension, were under a heavy tensile stress when the slab carried its full load.

The tension cracks in the concrete at the haunches were very fine and did not increase in width as did the cracks at the center of the arch, thus indicating little tension in the arch above the haunches.

TABLE I.

Slab Q. Age—54 days. Reinforcement 3-13-075.

DEFLECTIONS in 64ths of an inch.

Unit Load in lbs. per sq. ft.	Rod No. 1	Rod No. 2	Rod No. 3	Rod No. 4	Rod No. 5	Rod No. 6	Rod No. 7
0	0	0	0	0	0	0	0
154	—1	0	—1	—1	0	0	0
303	—1	—1	0	—2	+1	0	—1
457	—1	—1	—1	—3	0	—1	—1
609	—1	—1	—1	—4	0	—1	—1
760	—1	—2	—1	—6	—1	—1	—1
911	—1	—2	—1	—8	—1	—2	—1
1069	—1	—3	—1	—11	—1	—2	—1
1219	—1	—3	—1	—15	—1	—3	—1
1368	—1	......	......	—20	—1	—3	—1
1501	—1	......	......	—24	—1	—4	—1

NOTE:—The maximum deflection of No. 4 referred to No. 6 was $\frac{20}{64}$ in. The maximum load was allowed to remain on the slab for 15 hours and no increase in deflection was noted.

TABLE II.

Slab P. Age—55 days. Reinforcement 3-9-15.

DEFLECTIONS in 64ths of an inch.

Unit Load in lbs. per sq ft.	Rod No. 1	Rod No. 2	Rod No. 3	Rod No. 4	Rod No. 5	Rod No. 6	Rod No. 7
0	0	0	0	0	0	0	0
181	—1	—1	—1	—4	—1	—1	—1
360	—1	—2	—1	—6	—1	—1	—1
539	—1	—2	—1	—8	—1	—1	—1
706	—1	—3	—1	—12	—1	—2	—1
861	—2	—3	—1	—13	—1	—2	—2
1008	—2	—3	—1	—15	—1	—2	—2
1159	—2	—3	—1	—17	—1	—3	—2
1315	—2	—4	—1	—20	—1	—3	—2
1467	—3	.....	......	—24	—1	—4	—2
1619	—3	......	......	—27	—1	—4	—2
1770	—3	......	......	—30	—1	—4	—2
1923	—3	......	......	—34	—1	—5	—2
2075	—2	......	......	—38	—1	—4	—2
2230	FAILURE OCCURED.						

NOTE:—The maximum deflection of No. 4 referred to No. 6 was $\frac{34}{64}$ in.

TABLE III.

Slab O. Age—56 days Reinforcement 3 13-075.

DEFLECTIONS in 64ths of an inch.

Unit Load in lbs. per sq. ft.	Rod No. 1	Rod No. 2	Rod No. 3	Rod No. 4	Rod No. 5	Rod No. 6	Rod No. 7
0	0	0	0	0	0	0	0
166	0	—1	0	—1	—1	0	—1
326	+1	0	+1	0	0	+1	+1
488	+1	0	+1	—1	0	0	+1
635	+1	0	+1	—2	0	0	+1
796	+1	0	+1	—3	0	0	+1
948	+1	—1	+1	—6	0	0	+1
1080	+1	—1	+1	—8	0	—1	+1
1224	+1	—2	+1	—12	0	—1	+1
1355	+1	—2	+1	—15	......	......	+1
1501	+1	—2	+1	—19	......	......	+1

NOTE:—The maximum deflection of No. 4 referred to No. 6 was $\frac{17}{64}$ of an inch. The maximum load was allowed to remain on the slab for 5 days and the increase in deflection at the center of the slab was $\frac{1}{64}$ of an inch. On removing the load a permanent set of $\frac{1}{8}$ of an inch was observed at this point.

TABLE IV.

Slab N. Age—61 days. Reinforcement 3-9-175.

DEFLECTIONS in 64ths of an inch.

Unit Load in lbs. per sq. ft.	Rod No. 1	Rod No. 2	Rod No. 3	Rod No. 4	Rod No. 5	Rod No. 6	Rod No. 7
0	0	0	0	0	0	0	0
174	0	—1	0	—1	0	—1	—1
332	0	—1	—1	—3	0	—1	—1
498	—1	—2	—1	—4	—1	—2	—1
664	—1	—2	—1	—5	—1	—3	—1
833	—1	—3	—1	—7	—1	—4	—1
1024	—2	—4	—1	—9	—1	—4	—2
1177	—2	—4	—1	—12	—1	—5	—2
1319	—2	—4	—1	—14	—1	......	—2
1395	—2	—5	—1	—16	—1	......	......
1555	—2	—5	—1	—18	—1	......	......
1702	—2	—5	—1	—19	—1	......	......

NOTE:—The maximum deflection of No. 4 referred to No. 2 was $\frac{14}{64}$ of an inch. The maximum load was allowed to remain on the slab for 15 hours and the deflection at the center of the slab increased $\frac{1}{64}$ of an inch.

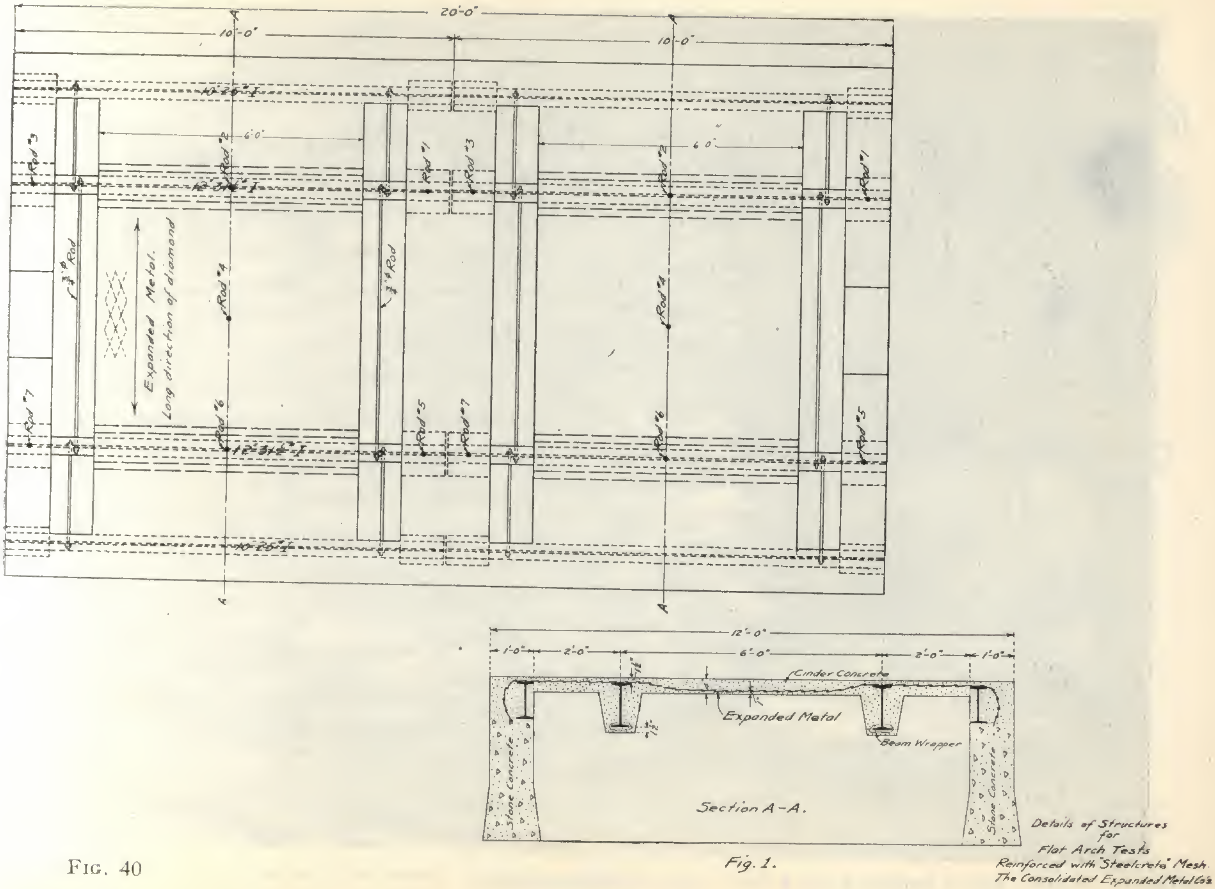
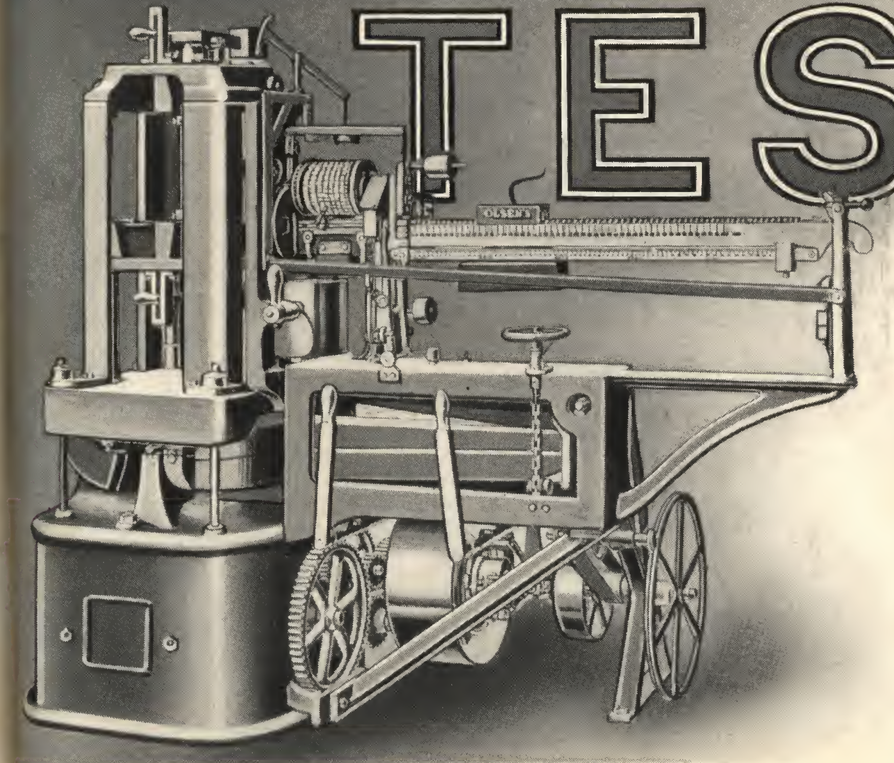

20'-0"
10'-0"
10'-0"
6'-0"
6'-0"
Rod #1
Rod #2
Rod #3
Rod #4
Rod #5
Rod #6
Rod #7
3/4" Rod
Expanded Metal.
Long direction of diamond
12'-0"
1'-0"
2'-0"
6'-0"
Cinder Concrete
Expanded Metal
Beam Wrapper
Stone Concrete
Section A-A.
Fig. 1.
Details of Structures
for
Flat Arch Tests
Reinforced with "Steelcrete" Mesh.
The Consolidated Expanded Metal Co's

FIG. 40

Slab O, reinforced with 3-13-075. Load of 1500 lbs. per. sq. ft. Deflection =17-64ths of an inch.

TESTS



THE
CONSOLIDATED
EXPANDED
METAL
COMPANIES

Steelcrete
TRADE MARK REGISTERED

TTSBURGH CHICAGO NEW YORK

Columbia University
in the City of New York
DEPARTMENT OF CIVIL ENGINEERING

July 8, 1914

The Consolidated Expanded Metal Co's.,
Braddock, Pennsylvania.

Gentlemen:-

Agreeable to your request I have made tension tests of your " Steelcrete" Mesh, the data for which I beg to enclose.

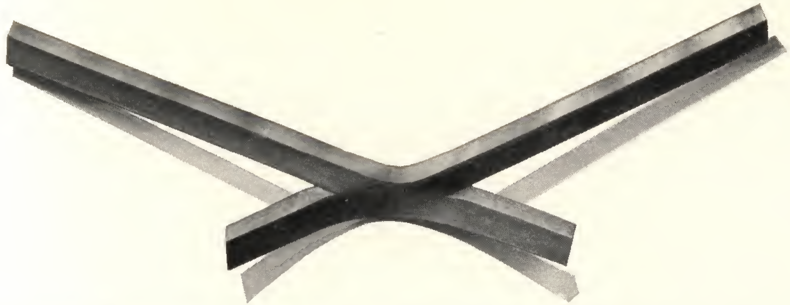
In preparing a test specimen, I cut a strand about seven inches long from the center of a sheet of Mesh. The strand included at its central part short lengths of the adjoining diamond. A cross section at the bridge(or center connection) equal to that of the strand beoween the bridges was obtained by filing. After this operation the test specimen represented the side of a diamond, including the obtuse angle. This strand was carefully straightened on a vise before testing. The intention in obtaining the test specimens in this manner was to determine the strength and properties of the material across the bridges or center connections.

The tests were made on an Olsen Universal Testing Machine of 1000 lb. capacity. The deflections were observed with an extensometer and readings were taken to 1/10,000 of an inch.

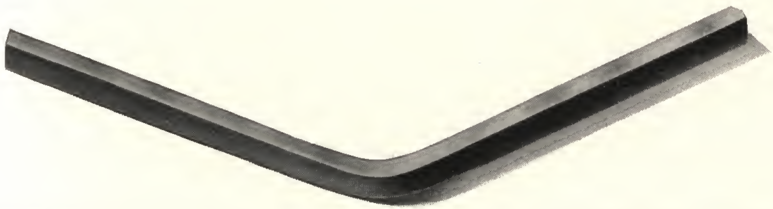
The stress-strain curves obtained are characteristic of cold-drawn steels. At your suggestion I am not fixing a value for any of the significant points of deformation.

Yours very truly,

James S. Macgregor



This photograph illustrates the first step taken in securing a specimen for the tensile tests conducted by Prof. Macgregor; a strand cut from the center of a sheet of "Steelcrete" mesh.



Illustrating the second step taken in preparing the specimens; observe the part removed.

The specimen after having been straightened, and ready for the tensile test, is here shown.

IT has been presumed that the reader of this pamphlet is familiar to a certain extent with the characteristic behavior of steel under tensile test. In order that the importance of the conclusions in this pamphlet may be emphasized, it will be recalled that when a steel specimen is tested in tension to destruction it passes through two well defined and significant stages. During the first stage, the elongations or deformations are comparatively small and increase approximately proportionate to the load. During the second stage there is a plastic yielding of the material which is attended by greatly increased elongations amounting at fracture to many hundred times the whole elongation occurring during the first stage.

Between these two stages there is a well defined point marked by a sudden increase of elongation which is easily noted when the readings are plotted on a chart. (See Curves, pages 168 and 169.) This point is generally termed in the literature of the steel industry, the "yield point" or "commercial elastic limit;" more accurately called, in foreign texts, the "rapidly-breaking-down point;" sometimes erroneously spoken of as the "elastic limit." At this point total failure does not occur, but the warping of the structure which follows ruins it for practical purposes. In the case of a steel which is to be used for reinforced concrete, this point is of great importance as actual failure occurs immediately after it is reached.

It was at one time widely thought among scientists, that steel was perfectly elastic up to a point called the "elastic limit," which we will here call the "theoretical elastic limit" (a point near the "commercial elastic limit" or "yield point" above mentioned). By "perfect elasticity" in the steel was meant that after having been stressed, it would recover its original length if the load were released; that is to say, at the "theoretical elastic limit" a permanent set took place. It is now known, however, that a permanent set can be detected soon after the load is applied, if only instruments precise enough are used.

It was also widely thought, among scientists, that within the "theoretical elastic limit" the stress or unit load was directly proportional to the strain or deformation. That is to say, if the stress and strain readings of a tensile test were plotted, a straight line would be observed up to the "theoretical elastic limit" which would by this definition be the "limit of proportionality." Many scientists may be cited who state that instead of a straight line a very flat curve will be obtained, if only precise enough instruments are used. In other words, the "limit of proportionality" was found to be reduced with the use of the most precise instruments.

A discussion of the "theoretical elastic limit" is of scientific interest only. It is unquestionable that the "limit of proportionality" is very close to actual facts. It is a point, however, which is commercially impractical to obtain and of doubtful significance. So far as commercial testing is concerned, the significant point which is recognized and taken account of, is the "yield point," the "commercial elastic limit," or "rapidly-breaking-down point." It is this point which is recognized by the Standard Specifications of the Association of American Steel Manufacturers representing practically all of the steel manufacturers in the United States.

It is a fact well known to steel men, that when mild or medium steel is subjected to tensile stress and the material begins to yield plastically (that is to say, the "yield point" or "commercial elastic limit" or "rapidly-breaking-down point" is reached) the unit load temporarily decreases which has the effect of causing the balance beam of a testing machine to drop. Thus the value of the "yield point" is noted at once during a test without recourse to a chart or plotted readings. This temporary drop in the unit load is noted in the diagram as a slight "kink" in the otherwise smooth curve. In the case of a mild steel which has been subjected to the process of cold drawing, as for example, "Steelcrete" mesh, this "kink" above referred to, does not appear, hence, in order to determine the value of the "yield point" in such a case, it is necessary to plot the stress-strain readings. This procedure is characteristic of all cold drawn steels. The behavior of a piece of steel under tensile test may be read at a glance from the plotted stress-strain curve and careful study of the ones hereinafter submitted is invited.

There are many empirical methods of fixing the value of the "yield point" used by the various commercial laboratories throughout the country. It is, however, beyond the scope of this pamphlet, to go into an analytical discussion of this phase of the subject.

In order to study the characteristics of the stress-strain diagram indicating the behavior of "Steelcrete" mesh under tensile stress and to determine the values of the significant points of deformation, the hereinafter described tests were conducted under the supervision of Prof. James S. Macgregor of the Columbia University Laboratories, New York City. The results of these tests will be found in the succeeding pages. The behavior of the specimens during test will be noted at a glance from the curve sheet (pages 8 and 9). The approximately straight portions of the curves in every case, exceed the unit value of 60,000 pounds per square inch, indicating that the "yield point" or "commercial elastic limit" exceeds this value. It will be recalled that the claims for this material, as indicated in the "Steelcrete" handbook are for a value of the "yield point" of not less than 55,000 pounds per square inch, which is greatly exceeded by the results of these tests.

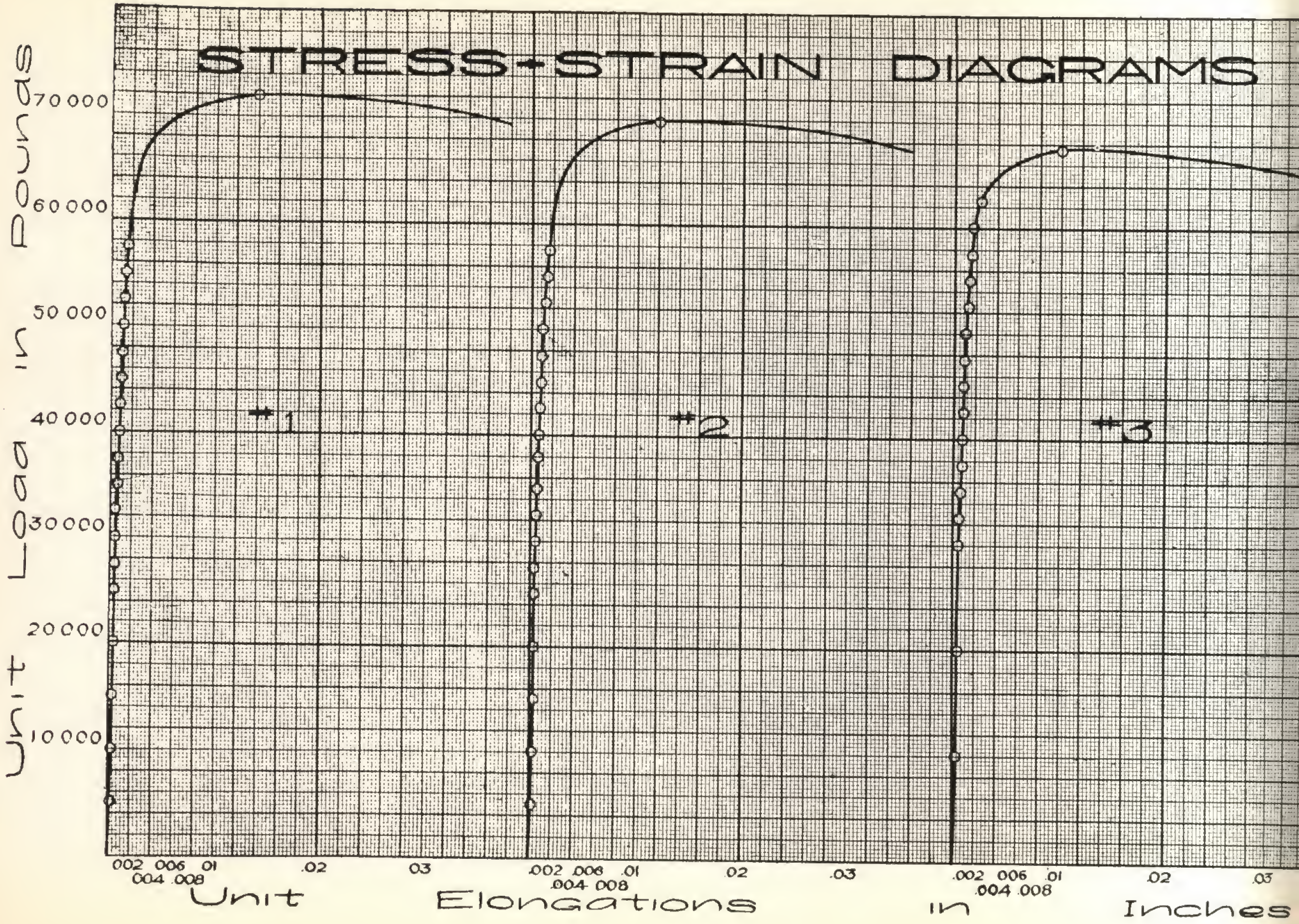
In order to remove all possible adverse criticism, strict instructions were given Mr. Macgregor to select the specimens from the center of a sheet of "Steelcrete" mesh and include at the central portion of the test specimens a bridge (or center connection between two diamonds). The manner in which the test specimens were prepared is described in his letter of transmittal hereinafter given. See also the photographs on page 163, which illustrate the successive steps required. No more exacting tests could be demanded of any steel reinforcing material than are here given. Not only with the motive of satisfying the most difficult specifications are the results of these tests submitted, but also with the end in view of meeting the increasingly critical demands of engineers and designers for detailed information of this character.

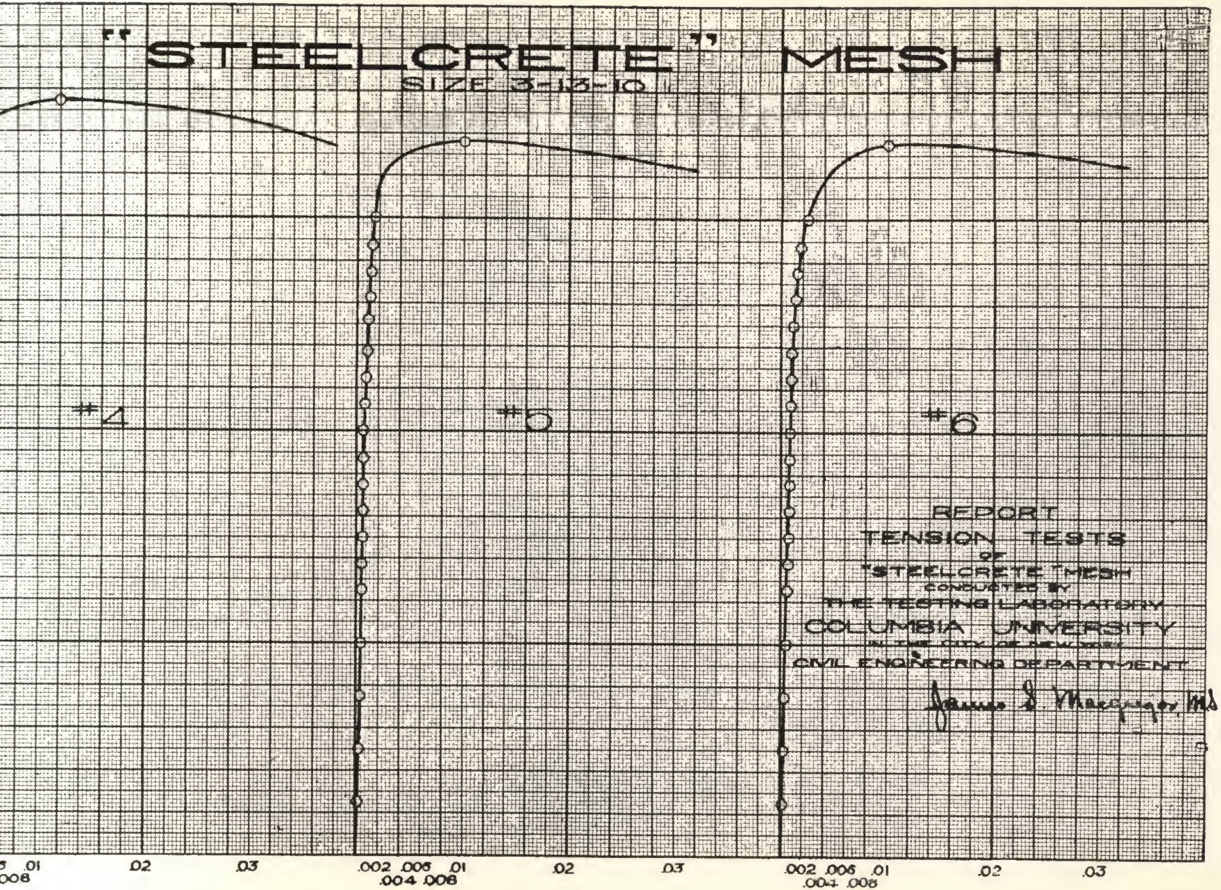
DUCTILITY

Ductility is one of the most important properties of steel required in structural designing. There are two ways of measuring the ductility of steel in common commercial use; (a) the percentage of elongation, (b) the percentage of reduction of area of cross-section.

The percentage of elongation is found by dividing the increase of length after rupture has occurred by the original length. The elongation of a test specimen may be divided into two portions; (a) that part of the elongation which is uniformly distributed over the length; (b) that part of the elongation which occurs in the close vicinity of the section which finally breaks. The accompanying sketch illustrates the "necking-down" action which occurs before rupture. The elongation is measured after rupture has occurred by placing the two ends together and measuring the distance between the original gauge marks.

It will be noted after a cursory inspection of these specimens that the elongation which is locally developed in the vicinity of final rupture, is not the same in all specimens but varies greatly with the diameter or thickness of the test specimen. It requires very little study to see that a piece of steel one inch in diameter will elongate much more in two inches of length adjoining the plane of rupture than a piece one quarter inch in diameter. In the former case almost all of the two inches represents the length of the "necking-down" portion, while in the latter case only a small part of the two inches represents this "necking-down" portion. The percentage of elongation in the two inches is much greater in the former case than in the latter; although the ductility of the latter steel may be the greater. This principle holds good for all commercial lengths of test specimens which usually run from two to eight inches.


STRESS-STRAIN DIAGRAMS
Unit Load in Pounds
70 000
60 000
50 000
40 000
30 000
20 000
10 000
#1
#2
#3
.002 .006 .01
.004 .008
.02
.03
Unit Elongations in Inches


"STEELCRETE" MESH
SIZE 3-13-10
#4
#5
#6
REPORT
TENSION TESTS
OF
"STEELCRETE" MESH
CONDUCTED BY
THE TESTING LABORATORY
COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK
CIVIL ENGINEERING DEPARTMENT
.01
.008
.02
.03
.002 .006 .01
.004 .008
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.03

As has been said before, the ultimate elongation in a test specimen of commercial length measures partly the plasticity of a short length at the "necking-down" portion and partly the plasticity of the bar before this drawing out commenced. It is obvious therefore, that in order to compare the ductility of different qualities of steel by the percentage of elongation, the diameter, thickness and shape of the test specimens as well as the gauge lengths, should be absolutely the same. It is not always possible to fulfill these conditions as the length and thickness of a commercial test specimen depends primarily on the size and shape of the finished product from which it is taken. It is possible, however, to compare the ductility of test specimens of different diameters, thicknesses and shapes as well as of different lengths by the percentage of the reduction of area at fracture.

"The term 'Reduction of Area' refers to a ruptured specimen and means the diminution in section area per unit of original area.......... Reduction of area, or contraction of area as it is often called, is an index of the ductility of the material and it is generally regarded as a more reliable index than elongation because the ultimate unit elongation is subject to variation with the ratio of the length of the specimen to its diameter, whereas the reduction of area is more constant." Merriman—"Mechanics of Materials." (1905), Page 31.

"The percentage of contraction of area and the quality of the fracture, both very important factors in determining the quality of the metal, are shown with equal accuracy and distinctness with the shorter specimen as with one of greater length." American Society of Testing Materials—1913.

The percentage of reduction of area is independent of the diameter, thickness, and shape of the test specimen as well as of the length.

While it would be possible to obtain a test specimen of "Steelcrete" mesh of the same length and thickness as is commonly used in steel bars, (i. e., 8 inches in gauge length and $\frac{7}{16}$ inch diameter), such a specimen would be subject to criticism as it does not represent a specimen of a finished product. In order to avoid all possible criticism, the specimens which have been tested were in every case taken from the center

of a commercial sheet of mesh. As the thickness, length and shape of the specimen thus obtained would be much less than the above mentioned standard size, the comparative ductility of "Steelcrete" mesh cannot be satisfactorily shown by the method of "percentage of elongation."

Any method of correcting the percentage of elongation of a specimen of "Steelcrete" mesh for the difference in section, shape and length would only be roughly approximate. Moreover, it would not be convincing, as it would require that the percentage of elongation actually obtained be greatly increased in order to make the comparison of any value whatever. The average percentage of elongation of the specimens tested by Prof. Macgregor of the Columbia University Testing Laboratory in New York City and elsewhere described, exceeds the requirements of the Manufacturers Standard Specification (1914) and of the American Society of Testing Materials (1913) for cold twisted square bars used in concrete reinforcement. This figure should be greatly increased in order to make the correction for the size and shape of the specimen. The percentage of reduction of area offers a more satisfactory method of comparison. The percentage of reduction of area of the test specimens of "Steelcrete" mesh investigated by Mr. Macgregor averaged forty per cent., indicating a high degree of ductility.

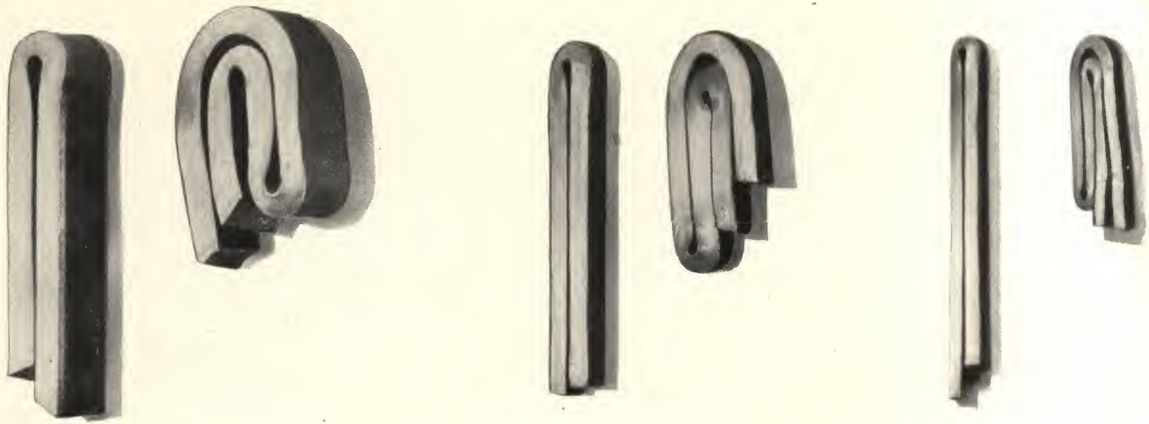
THE CHARACTER AND SIGNIFICANCE OF THE COLD-BEND TEST.

"The test of the ductility of a malleable metal by bending it cold is the most common and perhaps the most useful of all the tests which can be applied to it. For wrought iron and structural steel this test approaches more nearly to the severe usages of actual practice than does the tension test with its elastic limit, ultimate strength, elongation, and reduction of area. It is not so easily standardized, however, and it is employed less in America than in Europe, partly because no standard methods and results have been agreed upon here.

"If a sample of wrought iron or steel will, when cold, fold upon itself absolutely, or make the double fold (as shown in accompanying sketch), there can be no doubt of its high quality. When it fractures, however, at intermediate stages of this process, the question of its quality is left in doubt, and some standard limit is required if this test is to be made the basis of acceptance. The great advantage of this test is that it can be made at anytime in the shop, without the expense attaching to tension tests, and by the man who uses or makes up the material." Johnson, "The Materials of Construction" (1906), Page 394.

"The cold-bend test is one that has been known from the earliest times and which is constantly used in all mills where wrought iron or steel is produced. The bending of the specimen

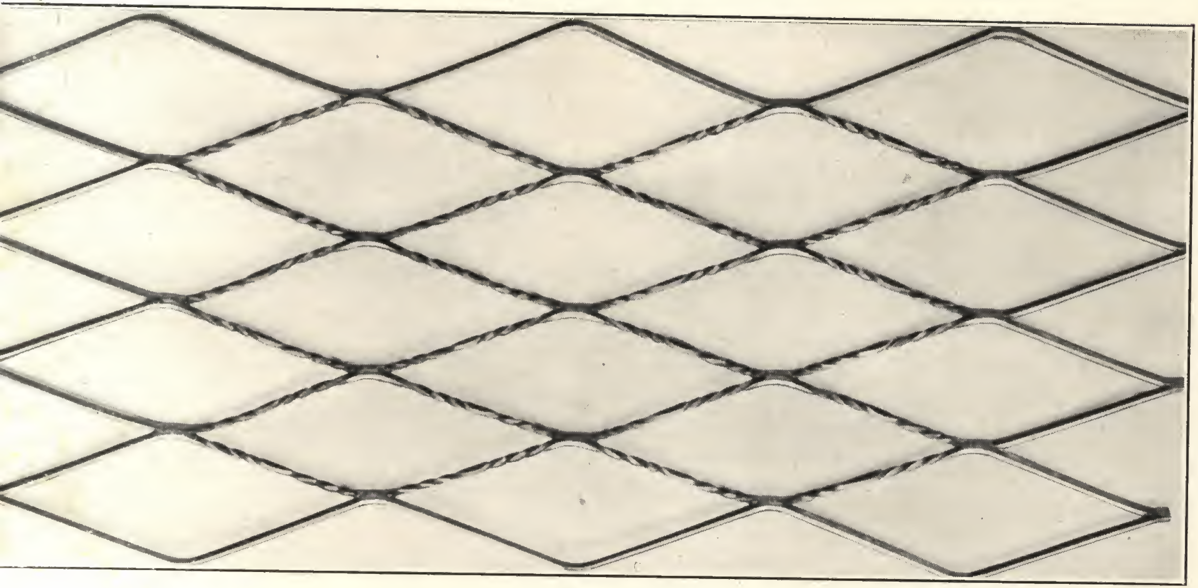
is generally done by blows of a hammer, although steady pressure is sometimes employed. Notwithstanding that no numerical results are obtained from the cold-bend test, except the final angle of bending, the general information that it gives is of the highest importance, so that it has been said that, if all tests of metals except one were to be abandoned, the cold-bend test should be the one to be retained. In the rolling mill it is used to judge of the purity and quality of the muck bar; in the steel mill it serves to classify and grade the material almost as well as chemical analysis can do, and in the purchase of shape iron it affords a quick and satisfactory method of estimating toughness, ductility, strength and capacity to resist external work." Merriman—"Mechanics of Materials" (1905), Page 439.



The above photographs show the most severe test of ductility and quality to which a piece of steel may be subjected; strands of "Steelcrete" mesh bent flat upon themselves through an angle of 180 degrees without any indication of fracture.

This method of testing is cited by Johnson in "The Materials of Construction" as approaching more nearly to the severe usages of actual practice than does the tension test, with its elastic limit, ultimate strength, elongation and reduction of area.

In referring to the value of the cold bend test, Professor Merriman states that if all tests of metal except one were abandoned, the cold bend test should be retained. It should be remembered that this test may be made by anyone at any time in the field.



Even more convincing than anything that has been said heretofore in this pamphlet in reference to ductility and uniformity of quality is the illustration of the cold twisted strands of "Steelcrete" mesh here shown. No indication of fracture can be detected. This test, like the one shown on the opposite page, can be made in the field by anyone on any commercial sheet of "Steelcrete" mesh.

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